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THE BULLETIN
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MECHANICAL MUSCLES*

A contract has been awarded to the General Electric (U.S.A.) for development and construction of a set of 'mechanical muscles' that will give an ordinary man the strength of a giant.

By means of an advanced system of levers, control linkages, and servomechanisms, this unique machine will mimic and amplify the movements of its operator—dramatically extending his strength and endurance. This man-machine marriage will essentially combine the operator's dexterity, brain-power, and all-round versatility with a machine's strength, size, and ruggedness.

A research prototype of the 'mechanical muscles' machine is now being developed at the General Electric Research and Development Center in Schenectady, New York.

Worn like an external skeleton, the 'mechanical muscles' machine—nicknamed HardiMan—will permit its operator to lift a 1,500-lb. load while exerting only a fraction of this force. He will be able to perform general load-handling tasks, including walking, lifting, climbing, pushing, and pulling. The machine—technically described as a 'powered exoskeleton' by its developers—will be attached to the operator at the feet, forearms, and waist.

Potential applications for the HardiMan are foreseen in warehouse and factory operations, bomb loading, and underwater salvage. Although the prototype will be connected to a separate power supply by means of flexible hydraulic lines, it is anticipated that later models will have self-contained power units.

The HardiMan project is funded under a program jointly supported by the U. S. Army Natick (Massachusetts) Laboratory and the U. S. Office of Naval Research.

The contract announced today resulted from 15 years of work on cybernetic anthropomorphous machines (CAMS) at the General Electric Research and Development Center. The engineering technology for 'force feedback' control—the key to HardiMan—was developed by Ralph S. Mosher, who will guide development of the machine.

Force feedback means that proportions of the forces generated or encountered by the machine are duplicated and reflected to the operator. If the machine's arm or leg strikes a solid object, the operator feels that identical force situation of striking a solid object with his arm or leg.

As a result, the machine simply becomes an extension of the man, and the operator is able to concern himself solely with performing the task at hand. Thus, man now has the ability to control a multi-motion machine in a natural way and to move loads at higher speed, with greater dexterity, than ever before. The control concept makes training time almost non-existent.

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* By courtesy of the Research and Development Centre, General Electric, U.S.A.

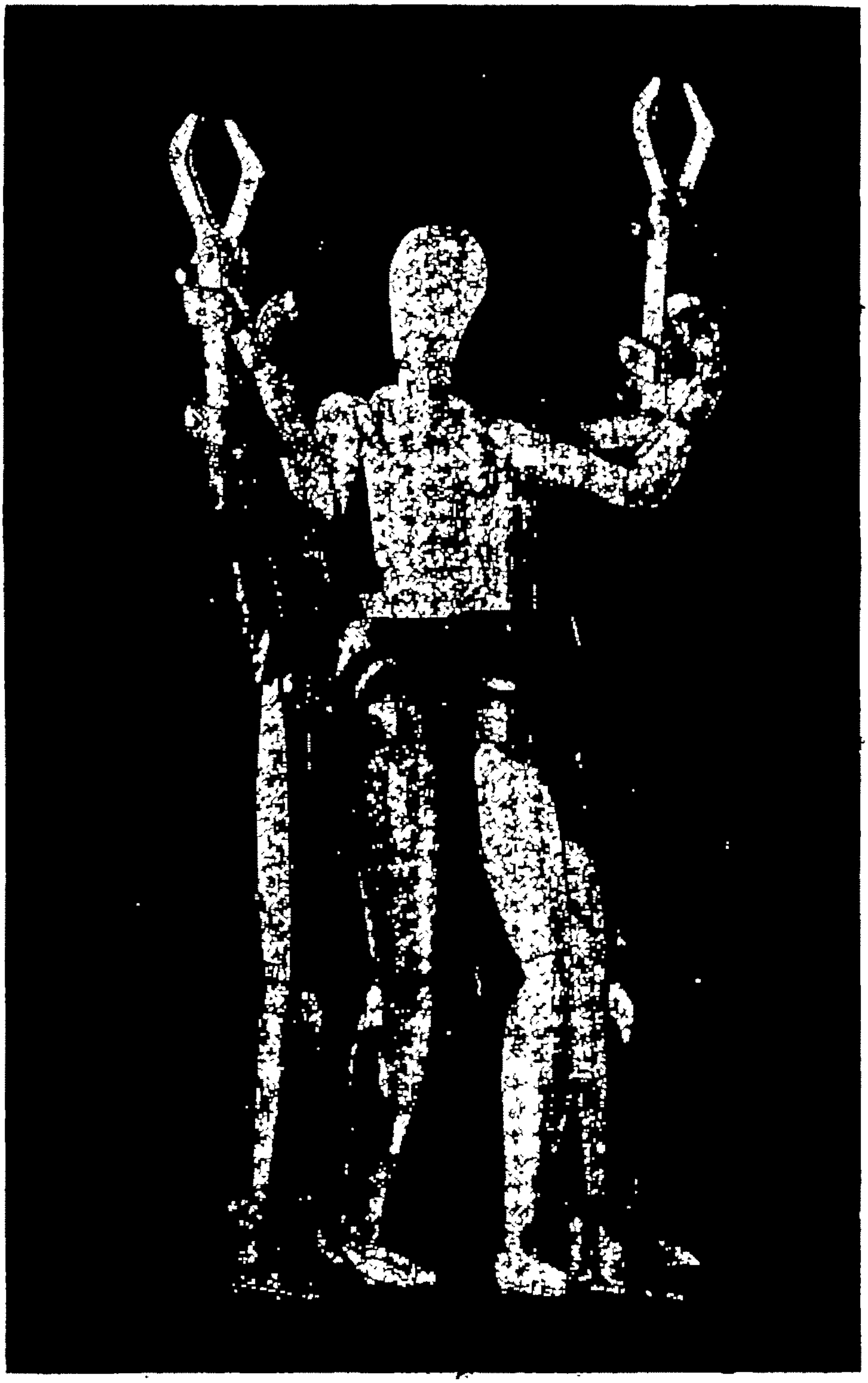

Fig. 1

A view of the HardiMan

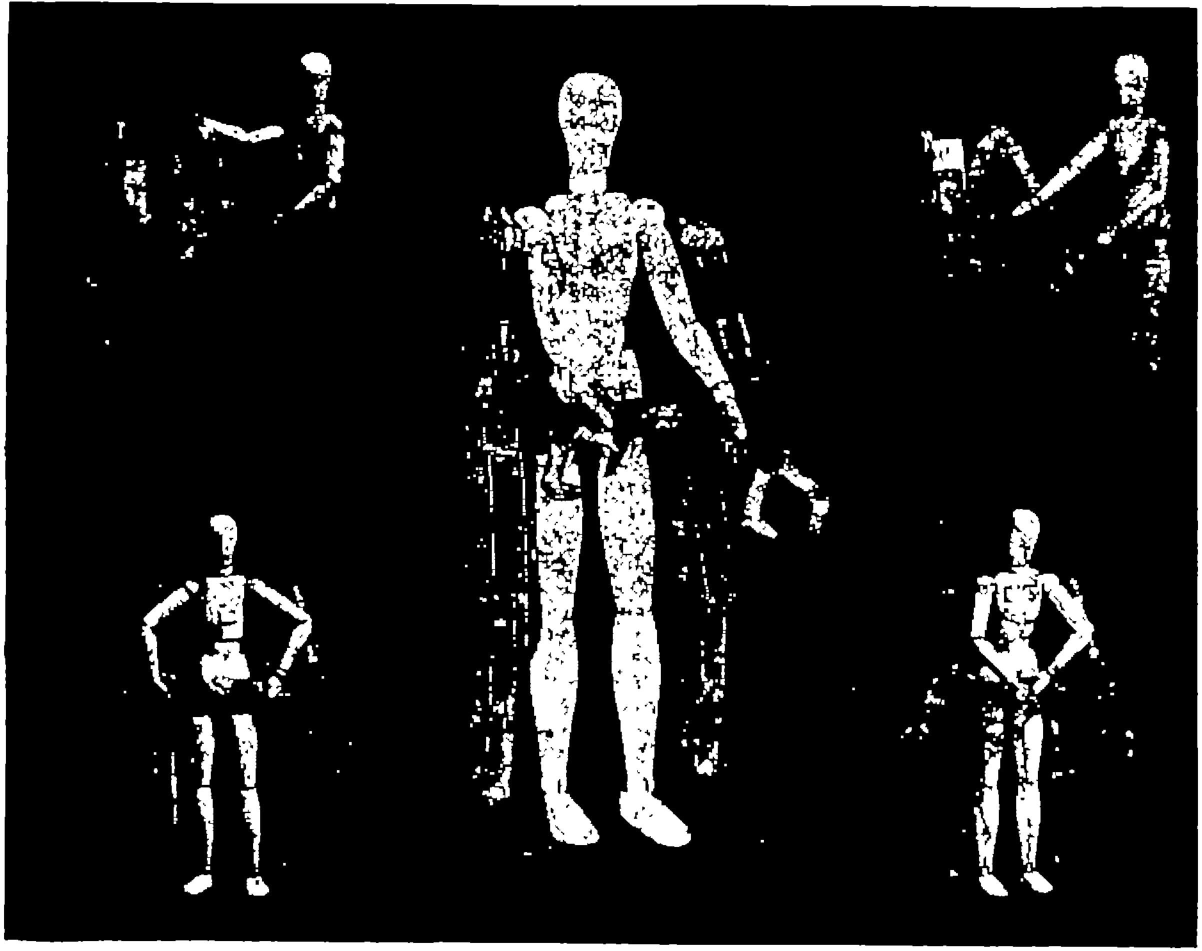

Fig. 2
A view of
the Hardi-
Man at
work

The effectiveness of a man-machine marriage was first demonstrated with the construction of a remote-controlled manipulator with two claw-like hands. Forces encountered by the 'slave' hands were fed back to the operator, enabling him to 'feel' what he was doing. As a result, he could handle dangerous substances—such as radioactive materials—from a safe distance.

The HardiMan machine will be controlled by hydromechanical servovalves —the mainstays of the force feedback system. The research prototype machine is scheduled for delivery in early 1968.

Fig. 1 shows the model of a set of 'mechanical muscles' that will give a the strength of a giant, and permit him to lift a 1,500-lb. load while exerting only a fraction of this force. Attached to its operator at his feet, forearms, and waist, the machine—nicknamed HardiMan—will mimic and amplify his movements, enabling him to perform a great variety of load-handling tasks.

Fig. 2 shows set of models of 'mechanical muscles' showing that the machine will be designed as two separate halves, each of which will include one arm, one leg, and one-half of the girth around its operator's waist.

MATERIALS TECHNOLOGY *

K. F. Antia

Member

Convenor, Panel on Materials Technology

The last decade has witnessed a revolution in the field of technology. Until recently, the approach to the harnessing of Nature's resources for the use of man was largely empirical or, at best, semi-empirical. It is now one of synthesis based on the fundamental principles of the physical sciences. While the engineer of the past proceeded to design on the basis of 'available' materials and their microscopic properties as revealed by experience, the engineer of the future will, in many cases, first design and then specify the building of the required materials to order. This requires an integrated treatment of some aspects of the physical sciences as 'materials technology'.

It is materials technology that can properly focus attention on the outstanding specific problems requiring solution for further advances in technology.

On ultimate analysis, every engineer has to work with materials found in nature or artificially produced. Their microscopic properties are evaluated and sometimes their chemical composition is determined. For their actual use either by shaping or processing, the only guide to the engineer was the result of test procedures which were very largely based on practical experience.

This type of course has gradually given way to the science of engineering materials.

In brief, the urge to make adequate provision for materials technology in some form or other constitutes an important feature of the new outlook.

The subject is developing rapidly to shape as a composite science and will soon take its rightful place as an independent discipline in the composite science of engineering, both for purposes of teaching and research. It has to incorporate in itself a considerable amount of physics, chemistry and related mathematics. But all these basic sciences have to be oriented specifically towards the desired objective, *viz.*, to enable the engineer of the future to properly specify the building of the required materials to order and, generally, to solve his materials problem with confidence.

'The materials ordinarily used or likely to be used and generally called engineering materials' have to be discussed scientifically by utilizing the background information that emerges from a synthesis of the physical sciences.

A rough indication of what is perhaps most appropriate as the scope of materials technology is given below.

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* The above note consists of extracts from a paper on 'Materials Technology' by Prof. S. V. Chandrashekhar Aiya published in the *Journal of Scientific and Industrial Research*, vol. 19A, no. 9.

1. **Physical sciences**

.1 Mathematics

(a) Statistics. Application to collection and analysis of data. (b) Fields, energy, and forces. (c) Quantum mechanics and statistical mechanics.

.2 Physics

(a) Elementary particles. (b) Structure of the atom. Periodic table. (c) Interatomic and intermolecular forces. Molecular structure. (d) States of aggregation. (e) Crystalline and amorphous structure. (f) Effect of temperature, irradiation and pressure on states of aggregation. (g) Ionized media. Effect of electric, magnetic, and electromagnetic fields. (h) Macroscopic laws and molecular interpretation.

.3 Chemistry

(a) Colloids. (b) Formation and structure of high polymers. (c) Phase transformation. (d) Building laws for condensed phases. (e) Reaction mechanisms in liquid systems. (f) Polyelectrolytes. (g) Chemistry of ionexchange resins. (h) Thermodynamics and kinetics of martensitic transformations.

2. Relationship between macroscopic properties of materials and their constitution

.1 Mechanical properties

(a) Elasticity, plasticity and flow. (b) Strength of materials. Effect of temperature, pressure and irradiation.

.2 Thermal properties

(a) Conduction and conductivity. (b) Insulation. (c) Expansion. (d) Shock resistance.

.3 Electrical properties

(a) Conduction and superconductivity. (b) Insulation. (c) Semiconductors. (d) Properties of dielectrics.

.4 Corrosion, its causes and cures

.5 Friction, wear and lubrication

.6 Coating, lining and cladding

3. Materials of construction

   .1 Metals

      (a) Extraction. (b) Methods of melting. (c) Methods of shaping. (d) Powder metallurgy. (e) Ferrous metals. (f) Nonferrous metals.

   .2 Ceramic and related materials

      (a) Stones. (b) Clay products. (c) Refractories. (d) Glasses.

   .3 Heat insulating materials

   .4 Electrical materials

      (a) Conductors. (b) Semiconductors. (c) Insulators. (d) Ferro-electric and ferro-magnetic materials. (e) Piezo-electric materials. (f) Magnetic films. (g) Dielectric materials.

   .5 Miscellaneous materials

      (a) Adhesives. (b) Inorganic cements. (c) Concrete. (d) Protective materials.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Poona Centre

Chairman's address by Col. R. V. Godbole, B.E., M.I.E., at the 7th Annual General Meeting of the Centre on March 26, 1966

After welcoming the Chief Guest, and other invitees, Col. Godbole thanked the Committee of the Centre for electing him once again the Chairman for the second year.

Delivering his address, Col. Godbole said, 'It would be seen from the report that though the student membership has gone down slightly, there is an increase in the number of Members, Associate Members and Graduate Members. A number of lectures on technical subjects were held during the year under review. Special mention must be made, here, of the Seminar on 'Statistical Techniques in Modern Management'. It was very encouraging to see that candidates were sponsored by various industrial undertakings throughout the country. The Poona Centre would like to further expand its activities in all fields of engineering, but we have been rather handicapped for want of accommodation. However, this Centre will continue to help the cause of advancement of engineering as has been done in the past.

I would like to share my thoughts with you on some of the current pressing problems where an engineer is directly or indirectly concerned. During the last conflict with Pakistan, the necessity of relying on ourselves for our defence requirements was fully realized. All efforts are being made by our Government to achieve the goal of self-sufficiency in military hardware. A challenge has thus been thrown to the Nation and particularly to the scientists and engineers. Here is, therefore, an opportunity for us to show that the engineers, as in the past, not only can, but do accept the challenge. This certainly will mean a very heavy demand on the creative and inventive faculties of engineers. This is the time for all of us to shed old time thinking, obsolete practices, and venture and even risk, if necessary, to uphold new thinking and practices in design, manufacture, maintenance and the use of materials. The present mental approach of trying to acquire the best in the world rather than to accept what can be produced in the country, must be ruthlessly curbed. Though the foreign collaboration in our industrial growth has its advantages, our progress must not, for ever, hang in balance for either lack or absence of the technical know-how from outside. This is the greatest challenge which must be accepted. The present mood of the country is being geared in this direction and our young scientists and engineers have made a start.

As regards the problem of 'shortage of food', though basically it is the domain of agriculturists, it will not be incorrect to say that the desired yield cannot be obtained without active cooperation of engineers. Here again, the engineers can play a decisive role in increasing the output. Without going into the statistics, it can safely be said that all the water resources in the country have not been harnessed to help the farmer. This is the task, engineers must tackle on a war footing. Engineers must impress upon the administrators to accept various schemes, big and small, for improvement of water resources for agriculture.

We will shortly be embarking on the Fourth Five-Year Plan. A seminar on 'The Role of Engineers in the Fourth Five-Year Plan' was held during the 46th Annual Convention of the Institution of Engineers (India) at Patna in January-February, 1966. During the seminar, a number of pertinent questions were debated also, in his presidential address, the President of our Institution referred to many pressing problems where an engineer can play an active role. He also brought out certain points where bold and immediate action is required to be taken by our Government. I wish to reiterate the thoughts put forward by our President, and sincerely hope that the Government will move in the matter immediately. Some of the important points mentioned by the President are: (i) Appointment of engineer-administrators to the Government undertakings which are predominantly technical in nature; (ii) Seeking the services of eminent and talented consultants of our own country rather than of those hailing from outside; and (iii) Treating the contractors as equal partners of engineers. As regards the contractor-engineer relationship, I had brought out, during my speech last year, the necessity of Builders Association of India forming a code of conduct for the contracting agencies. I regret to say that no action appears to have been taken by the Association in this regard. It is, I feel, the legitimate task of the Builders Association of India to approach the Government and improve the present status of contractors.

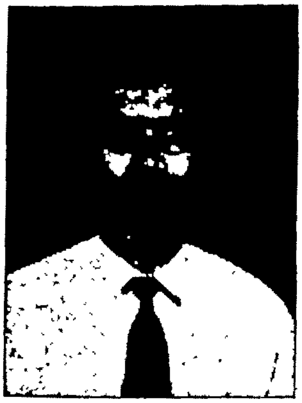
As already mentioned, the Poona Centre of the Institution of Engineers, (India) in all sincerity, wishes to associate itself with encouraging and helping engineers to give their mite in overcoming the present difficult situation.

However, we are rather handicapped for want of minimum accommodation. I, am sure, therefore, you will bear with me if I therefore, renew my appeal to all industrialists and every person connected directly or indirectly with any field of engineering to contribute generously to our 'building fund' so that we may complete the planned construction and get on more efficiently with the job of advancing the cause of engineering which is so vital in the present times.'

Punjab Centre

Chairman's address by Shri S. Kulbir Singh, M.I.E., at the 21st Annual General Meeting of the Centre on December 17, 1965

After welcoming the Chief Guest—the Governor of Punjab—and other invitees, Shri Singh thanked the Committee of the Centre for electing him the Chairman for the ensuing year.



Delivering his address, Shri Singh said, 'In this age of specialisation, the Engineers tend to concentrate in their respective individual fields of activity. Mutual interaction and intermingling which are indispensable for a proper balance and cohesion are often lost sight of. The engineers are concerned much more with achievement but more often, they overlook the need and importance of exchange of ideas. This lack of cohesion and of the power of self expression in the profession of Engineering in India was recognised about 50 years ago and in 1918 it received public prominence in the report of the Industrial Commission 1916-18 of which Sir Thomas Holland, the then Commerce Member of the Government of India, was the chairman. Finally on February 23, 1921, the Institution was inaugurated in Calcutta. The Institution grew by leaps and bounds. The Local Centres having State-wide jurisdictions began springing up. The Punjab Centre came into existence in 1943 in Lahore. There, it did not flourish much because it had to compete with a much older and well established organisation, the Punjab Engineering Congress. This body which had its roots in Lahore was not revived in the Punjab after the partition in 1947. This was a blessing in disguise, for it unified the engineering profession of the Punjab into one common forum, the Punjab Centre. This Centre has made much progress since 1948. The number of its Corporate Members which stood at 110 in 1948 has now risen to 313. The number of Students which was 213 in 1948 has now swelled to 3,881. In several other directions too, the Institution has taken rapid and long strides of progress.

Achievements of the Punjab in the post-independence era are plentiful. Bhakra Dam, the vast source of power and irrigation water, speaks for itself. The canal system of the State is perhaps one of the finest in the world. Since Independence, a vast network of roads has taken shape. The generation of power has increased manifold. The Capital project, 'Chandigarh' is a standing tribute to the vision and skill of the engineers. Technical education has also made rapid strides.

Yet there is much more to be done and of this none is more conscious than the technologist himself. He is actualy aware of the poverty and want which beset and torment his country. He is fully cognisant of the dangers posed by intransigent and hostile neighbours. And above all, he knows that, as always, in this hour of trial, his contribution is needed the most.

All battles—be they against poverty, be they against want and penury, be they against hostile neighbours—will be won in the fields of technology. In words of our late Prime Minister, Shri Nehru, '......Only science can successfully be applied to solve country's social and economic problems.. I am more and more convinced that the tasks can only be done by scientists and engineers'. He further said, 'The person who is important today is the engineer, the scientist and the technical man. The fact remains that the type of specialised work like that of the engineers or scientists is becoming more and more important. The future of the country will depend more and more on them rather than the administrators'.

Such were the sentiments of one of the great thinkers of our times and these are shared by all right thinking persons. It has been said repeatedly by many wise and far-seeing men that without engineering skill the world would have made little progress.

What is true of the world in a general way, applies with equal force to the State of Punjab. The role of the engineers is no less vital here. An examination of the Five-Year Plans shows that for utilization of over 70% of allocations, the State depends on its engineers. To almost every field, especially developmental, they make a substantial contribution. Without their work the Punjab's economy which had been utterly disrupted by the partition would not have been rebuilt.

Fortunately, the work of the engineers has never been underrated. It has almost invariably received high praise from people in high places and low. Its vital impact on the State's economy and on the common man's welfare has been recognized freely. Yet, the worth as distinct from the work of engineer, has received inadequate consideration. In the State services, he has been given the feeling of being controlled. He is to be led by the men in another service. His emoluments, which by virtue of his specialised training and work should have been the highest, are nowhere near the mark. His is perhaps the only service of which the pay scales of some grades have suffered a downward revision since partition. This appears to be paradoxical, but is yet true. The status and emoluments of its members should vary with their role. When it is recognized unreservedly that the role of the engineering services in the country's welfare is the most prominent, the status and emoluments of engineers should also be the highest. It is not necessary to adhere blindly to the patterns followed by the Britishers when they ruled over India. Then, the maintenance of British Raj was the principal aim, if not the only concern of the Government. Those who helped most in its perpetuation were given the place of pride—the highest status and the highest emoluments. Now the emphasis has shifted to the service and welfare of the common man. He who makes the maximum contribution towards it should rank the highest.

Over one and a half decade the dangers of relegating the engineering services to a secondary position have been voiced stridently from this platform. But this is regrettable that the advice has remained unheeded. On the contrary it is deplorable that during this period the conditions have been made more humiliating for men in the engineering services.

Sir, this is a frank and correct assessment of the situation as it exists today. I have translated into words the views of those who are today in the position of leadership of the engineering profession, of those who have a knowledge of the pulse of men in the engineering service, those who understand their urges and aspirations. As their spokesman, from this platform once again, I take the liberty of voicing their sentiments. It is our earnest hope that they will not go unheeded this time.

In the engineering profession of the Punjab, there are men of high ideals and high abilities. They yearn for exploring new horizons, reaching new frontiers, making new discoveries and employing new techniques. Given the necessary freedom and facilities, they will take their country to the noon of welfare and prosperity.'

INSTITUTION NOTICES

Draft Indian Standards

The following draft Indian Standard have been issued recently.

1. Draft Indian Standard Code of Practice for External Facings and Veneers: (i) Part 1—Stone Facing; and (ii) Part 2—Cement Concrete Facing.

This standard covers fining of stone facing and veneering on the exterior of walls.

Members may send their comments on this draft standard before October 31, 1966, to Shri T. R. Mehandru (*M.*), 14 Asaf Ali Road, Ajmeri Gate Extension, New Delhi, who is the Institution representative on the Sectional Committee dealing with this Standard.

2. Draft Indian Standard Code of Practice for Laying of Glazed Stoneware Pipes—Doc: BDC (1049).

This standard covers the methods of laying glazed stoneware pipes below ground level for drainage purposes. It also includes handling and jointing of pipes, tests, backfilling, restoration and maintenance of surfaces.

Members may send their comments on this draft standard before November 10, 1966, to Shri M. V. Modak (*M.*), c/o. Duncan Stratton and Co. Ltd., 29 Bank Street, Fort, Bombay 1, who is the Institution representative on the Sectional Committee dealing with this Standard.

3. Draft Indian Standard for Rectangular Prestressed Steel Tanks (Revision of I.S.: 804-1958)—Doc: SMBDC 7.

4. Draft Indian Standard Code of Practice for Steel Tubular Scaffolding; Part 1: Definition and Materials—Doc: SMBDC 7(602); and Part 2: Safety Regulations for Scaffolding—Doc: SMBDC 7 (720).

Part 1 of the Code of Practice covers some of the common definitions and general guidance for the construction and use of scaffolds and other structures of tubular scaffolding materials used in construction. Part 2 covers safety regulations that will be observed in the design and construction of scaffolding.

Members may send their comments on these draft standards before November 15, 1966, to Shri D. C. Sharma (*M.*), 4E Sector 9C, Chandigarh, Punjab, who is the Institution representative on the Sectional Committee dealing with these Standards.

5. Draft Indian Standard Code of Practice for Ancillary Structures in Sewerage Systems—Part 1: Manholes—Doc: BDC 24 (1110); Part 2: Flushing Tanks—Doc: BDC 24 (1110); and Part 3: Inverted Siphon—Doc: 24 (1111).

Part 1 of the Standard covers the requirements for design considerations, materials construction, spacing, performance requirements, safety measures to be adopted and types manholes. Part 2 covers the requirements for location and design consideration of flushing, quantity and velocity of flush water. Part 3 covers the requirements for design consideration, materials, construction, safety measures to be adopted, etc., in inverted siphon.

Members may send their comments on these Codes before November 20, 1966, to Shri N. V. Modak (*M.*), c/o. Duncan Stratton and Co. Ltd., 29 Bank Street, Fort, Bombay 1, who is the Institution representative on the Sectional Committee dealing with these Standards.

6. Draft Indian Standard Code of Practice for Design and Installation of Expansion and Contraction Joints in Buildings—Doc: BDC 13 (1088).

This Standard deals with the designs and installation of expansion and contraction joints in masonry and concrete in buildings.

Members may send their comments on this draft Code before November 15, 1966, to Shri T. R. Mehandru (*M.*), 14 Asaf Ali Road, Ajmeri Gate Extension, New Delhi, who is the Institution representative on the Sectional Committee dealing with this Standard.

7. Draft Indian Standard Specifications (Revision of I.S.: 2556—1963) for (i) Vitreous Sanitary Appliances (Vitreous China)—Part 4: Specific Requirements of Wash Basins—Doc: BDC 3 (1042); Part 5: Specific Requirements of Laboratory Sinks—Doc: BDC 3 (1043); and Part 6: Specific Requirements of Urinals—Doc: BDC 3 (1044).

Members may send their comments on this draft Standard before November 15, 1966, to Shri B. B. Rau (*A.M.*), Deputy Assistant Director, Central Public Health Engineering Organisation, Wing 9, Patiala House Annexe, Tilak Marg, New Delhi 1, who is the Institution representative on the Sectional Committee dealing with this Standard.

Copies of the draft Standards may be obtained from the office of Indian Standards Institution, 'Manak Bhavan', 9 Bahadur Shah Zafar Marg, New Delhi 1, or from its branch offices at Bombay Mutual Terrace, Sandhurst Bridge, Bombay 7; 5 Chowringhee Approach, Calcutta 13, 14/69 Civil Lines, Kanpur, or 54 General Patters Road, Madras 2.

INSTITUTION NEWS

President's Itinerary

On August 9, 1966, the President, Shri B. P. Kapadia, was the Chief Guest at the Fellowship Meeting of the Mysore Local Centre, Bangalore, and addressed the members present. The next day he inaugurated the Students' Chapter of the Mysore City Sub-Centre at Mysore. He also inaugurated the Institution Book Bank at the National Institute of Engineering, Mysore. The Mysore City Sub-Centre was 'At Home' to the President in honour of his visit. On August 12, the President addressed the Students' Chapter of the Mysore Local Centre, which was 'At Home' to the President in honour of his visit. On August 14, the President addressed the Students' Chapter at Hubli and also met the members of the Dharwar Sub-Centre. The President was the Chief Guest at the inauguration of the Dharwar Sub-Centre.

On August 24, Shri Kapadia visited the Allahabad Sub-Centre for two days during which he was the Chief Guest at a luncheon given by Shri J. P. Mital, Chairman, Allahabad Sub-Centre, where he was introduced to the members of the Executive Committee of the Sub-Centre.

The President also visited the Allahabad Polytechnic and later met the army engineers stationed at Allahabad. On August 25, Shri Kapadia inaugurated the Annual Session of the Agricultural Engineering Society in the Agricultural Institute, Naini. He also visited the works of the General Electric Co. of India, (Private) Ltd., at Naini. The President visited the Motilal Nehru Regional Engineering College, where he inaugurated the Institution Book Bank and addressed the students and staff members. In the evening the President inaugurated the Students' Chapter of the Institution in the Allahabad Polytechnic.

Shri Kapadia paid a visit to the Allahabad Fort and the *Sangam* in the morning of August 26, and later visited Bamrauli Airport, Allahabad, on invitation by engineer-officers posted at the Airport. The President left for Bombay via Delhi by air at 11.00 a.m. on the same day.

Inclusion of the Chairman of the Andhra Pradesh Centre in the State Advisory Committee for Planning

The Government of Andhra Pradesh has recently reconstituted the State Advisory Committee for Planning and has included the Chairman of the Andhra Pradesh Centre of the Institution as a member of the Committee. The Committee will be the Chief Consultative Body to advise the State Government on the broader principles of planning, the phases in which development programmes should be executed and the role of non-official agencies in the implementation of the development programmes. The Committee will also recommend measures and review progress particularly with reference to public cooperation and participation in the Plan programme.

Third Congress of the International Federation of Automatic Control, London, June 1966

The Third Congress of the International Federation of Automatic Control was held at the Institution of Mechanical Engineers, London, from June 20 to 25, 1966. The Institution of Mechanical Engineers holds stocks of literature presented at the Congress, *viz.*, (1) Book of 289 Congress Paper Abstracts, in English, French, German or Russian ($5.00); (2) 10 Survey Papers ($10.00); (3) Set of Preprints (49 Technical Sessions and Informal Discussion Sessions) ($50.00); (4) Volume of Discussions and Authors' Replies, etc. ($15.00); and (5) Complete set of Proceedings, including items 1 to 4 above, etc. (bound) ($80.00).

As the Institution of Engineers (India) is the National Member Organization of the IFAC, order forms can be obtained from the Assistant Secretary (Technical) of the Headquarters Office and payments hould be made in U.S. dollars or Sterling direct to the Institution of Mechanical Engineers, London.

FORTHCOMING EVENTS

Seminar on 'Battery Powered Vehicles', Calcutta, November 23, 1966

The Indian Lead Zinc Information Centre, Calcutta, is organizing a Seminar on 'Battery Powered Vehicles' with particular emphasis on Battery Operated Cars, together with a photographic exhibition at the Saturday Club, Calcutta, on November 23, 1966. The primary object of the Seminar is to present to Indian manufacturers, entrepreneurs, engineers and all interested in the field of transport, the latest developments that are taking place abroad. A preliminary study carried out by the Centre has shown that the electric car has great potential in India and in fact recent developments in the U.K. and the U.S.A. indicate that India is the most ideal country to start any large scale venture in this field. The seminar will afford an opportunity to discuss the potentialities for manufacture in this country for local consumption as well as for export. It will also discuss commercial, industrial and other special types of battery operated vehicles. Papers are invited on any aspect of battery vehicles.

Further details may be obtained from the Indian Lead Zinc Information Centre, 5A Lord Sinha Road, Calcutta 16.

4th National Metallurgist's Day, Rourkela, November 14-16, 1966

The 4th National Metallurgist's Day and the 20th Annual Technical Meeting of the Indian Institute of Metals will be held at Rourkela from November 14-16, 1966. The function, organized by the Indian Institute of Metals with the Rourkela Steel Plant as the host, will be inaugurated by Shri T. N. Singh, Union Minister for Iron and Steel. Highlights of the technical programme include symposia on (i) 'Manufacture of Flat Products'; and (ii) 'Use of Non-Ferrous Metals in Engineering Industry'.

Further details can be obtained from The Indian Institute of Metals, 31 Chowringhee Road, Calcutta 16.

Symposium on 'Ultimate Load Method of Design of of Structures', Coimbatore, November 1966

A Symposium on 'Ultimate Load Method of Design of Structures' will be held at the P.S.G. College of Technology, Coimbatore, in the third week of November 1966. Prof. G. S. Ramaswamy, Director, Structural Engineering Research Centre, Roorkee, will inaugurate the Symposium.

Further details can be obtained from Dr. V. Ramakrishnan, Head of the Department of Civil Engineering, P. S. G. College of Technology, Coimbatore 4, Madras State.

Symposium on 'Site Investigation for Foundation', Roorkee, March 6-8, 1967

A Symposium on 'Site Investigation for Foundation' will be held at the

Central Building Research Institute, Roorkee, from March 6-8, 1967. The symposium will deal with the following subjects:

(i) Organization, planning and economics of site investigations;

(ii) Methods and extent of investigation (aerial survey and mapping, geological and geophysical exploration, boring techniques, sampling techniques);

(iii) *In-situ* tests (load tests, penetration tests, field vane shear tests, *in-situ* moisture density measurements); and

(iv) Special site investigations for specific purpose (roads and runways, embankments, machine foundations, nuclear power installations, rocket sites, etc.).

Further details can be obtained from the Central Building Research Institute, Roorkee, U.P.

Fifth International Conference of Engineers, Athens, May 7-12, 1967

The 5th International Conference of Engineers will be held in Athens, Greece, from May 7-12, 1967. The theme of the Conference is 'The Engineer and Social and Economic Progress' and the Conference will consider the present-day problems of the European Engineer. The four main topics to be considered are:

1. The Engineer, creator of scientific and technical progress—his place in relation to the pure scientist in the field of research and development.
2. The Engineer, creator of economic expansion—his role in the exploitation of scientific and technological discoveries.
3. The education of the Engineer to enable him to meet his scientific and technical responsibilities—his education and training initially and throughout his career.
4. The Engineer, creator of social progress—his role in urban development.

Further details can be obtained from FEANI Vth Congress Organising Committee, 4 Karageorgi Servias Street, P.O. Box 673, Athens, Greece.

Tenth International Gas Conference, Hamburg, June 6-10, 1967

The 10th International Gas Conference will be held in Hamburg, Federal Republic of Germany, from June 6-10, 1967. This Conference which is organized every three years by the International Gas Union (I.G.U.) provides a forum for gas technologists from all parts of the world. The Conference will provide an opportunity to all interested in development in the gas industry to gather information on the most recent achievements in gas engineering. In addition to the reports of the seven I.G.U. Committees, 80 individual papers will be presented and discussed. The topics to be considered range throughout the whole field of gas engineering including new developments in the sphere of traditional gas production, problems associated with extraction and processing of natural gas, the transmission and distribution of gas and modern methods of gas utilization.

Further details can be obtained from the Sekretariat, 10 Internationaler Kongress der gasindustrie, 2000 Hamburg 1, Kurze Mühren 1, Federal Republic of Germany.

IFAC Symposium on 'The Problems of Identification in Automatic Control Systems', Prague, June 12-17, 1967

The Institute of Information Theory and Automation of the Czechoslovak Academy of Sciences will hold a Symposium on 'The Problems of Identification in Automatic Control Systems' in Prague from June 12-15, 1967. The scientific and technical programme of the Symposium include the following topics:

1. Fundamental mathematical problems.
2. The mathematico-physical analysis of the dynamic characteristics of systems.
3. Statistical methods of identification and process parameter estimation.
4. Identification of the dynamic characteristics of systems through the evaluation of determined signals.
5. Identification of systems by means of adaptive models.
6. Special instruments for identification and process parameter estimation.

Further details can be obtained from the Organising Committee of the IFAC Symposium, Czechoslovak Academy of Sciences, Institute of Information Theory and Automation, Vyschardska 49, Prague 2, Czechoslovakia.

Next Congresses of the IFAC

The Fourth Congress of the International Federation of Automatic Control (IFAC) is planned to be held in Warsaw, Poland, from June 16-21, 1969; the Fifth Congress in France in 1972, and the Sixth Congress in the United States of America in 1975.

Conference on Computer Technology, Manchester, July 18-20, 1967

A Conference on 'Computer Technology', organized jointly by the Electronics Division of the Institution of Electrical Engineers and the Institution of Electronic and Radio Engineers, will be held at the University of Manchester, Institute of Science and Technology, from July 18-20, 1967. The scope of the meeting will include: (i) Central processor hardware; (ii) Hardware problems associated with multi-processing (dynamic addressing, etc.); (iii) Input and output devices for new applications; (iv) Data links; (v) Graphic input and display units; (vi) Image handling devices; (vii) Reliability and maintenance; (viii) All aspects of storage; and (ix) Components and devices. The Organising Committee invites contributions of up to 2,500 words for consideration for inclusion in the Conference programme.

Further details and registration forms will be available from the Joint Conference Secretariat, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

Acoustic Noise and Its Control Conference, London, January 23-26, 1967

A Conference on 'Acoustic Noise and Its Control' will be held at the Institution of Electrical Engineers, London, from January 23-26, 1967. Topics to be discussed will include the subjective aspects of noise problems, the nature of the human perception of noise, and the analysis and measurement of noise. Consideration will be given to the ways in which noise is generated in machines and the techniques that are necessary to reduce it to acceptable levels. Methods of reducing internally the noise generated inside a building and methods of impeding its transmission through the structure will also bediscussed.

Registration forms and further details are available from the Joint Conference Secretariat, The Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Fifth Congress of the International Association for Analogue Computation, Lausanne, August 28-September 2, 1967

The International Association for Analogue Computation (AICA) will hold its fifth Congress in Lausanne, Switzerland, from August 28-September 2, 1967. The general programme includes the following main topics for discussion at the Congress: (i) New Mathematical Techniques for Analogue and Hybrid Computation—Theory; (ii) Applications of Analogue and Hybrid Computors; (iii) Components and Systems of Analogue and Hybrid Computors; and (iv) Digital and Hybrid Software. Authors wishing to contribute papers for inclusion in the programme of the Congress should submit a provisional abstract of not more than 600 words to the Congress Secretariat for scrutiny.

Further information can be obtained from Sekretariat dei Schweizerischen Gesellschaft für Automatik, Wasserwerkstrasse 53, CH 8006 Zurich, Switzerland.

High Pressure Engineering Conference, London, September 11-15, 1967

The Applied Mechanics Group of The Institution of Mechanical Engineers, London, will be holding a five-day Conference on 'High Pressure Engineering' from September 11-15, 1967, at the Imperial College of Science and Technology, London.

Papers and reviews are now being sought covering recent work done on high pressure equipment and processes where the pressure involved causes a departure from conventional engineering techniques. Within this context, generation, transmission, containment and material properties will be examined together with extrusion and pressing processes covering both the hardware and material involved.

Further details can be obtained from The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S.W. 1.

MF, LF, and VLF Radio Propagation Conference, London, November 8-10, 1967

The Institution of Electrical Engineers, London, will hold a Conference on 'MF, LF, and VLF, Radio Propagation' in London from November 8-10, 1967. Sponsored by the Electronics Division of IEE and the Institution of Electronic and Radio Engineers, the scope of the Conference will include: (i) Navigational aids; communication; (ii) The effect of ground, coastline and climate; (iii) Ionosphere irregularities, absorption, movement and nonlinear effects; (iv) Waveguide mode and ray theories; (v) Excitation factors; (vi) Phase and field strength stability; (vii) Atmospherics; (viii) VLF in the magnetosphere; and (ix) Subsurface propagation.

Those wishing to offer material should submit synopses of about 200 words by January 31, 1967, to the Joint Conference Secretariat.

Further details and registration forms are available from the Joint Conference Secretariat, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

BOOK ACKNOWLEDGMENTS

1. **Prefabrication of Reinforced Concrete.** P. Dyachenko and S. Mirotvorsky. *Peace Publishers*, Moscow, 239 pages.

This book is intended to be of help to the personnel in charge of the various departments and subdivisions of up-to-date precast concrete works, and to the operators of individual pieces of equipment, for it offers information on numerous manufacturing process, principles of handling modern machinery and the trend of engineering that has led to the development of such machinery.

2. **The Fitter.** E. Grytz. *Asia Publishing House*, 1965, 182 pages.

This book, pertaining to a series entitled 'Technical Fundamentals' describes techniques and tools used by the fitter.

3. **Steam Turbines—Theory and Design.** P. Shlyakhim. *Peace Publishers*, Moscow, 240 pages.

This volume is intended as a text-book for the students of technical colleges as well as engineers and designers specialising in turbine building. Basic theoretical concepts of the thermodynamic processes of stationary steam turbines have been dealt with in detail. Variable load operation of these turbines has also been considered. The basic concept of gas dynamics applied to steam turbines as well as design and construction of steam turbines and their details with regard to mechanical strength are dealt with. Considerable space has been devoted to the description of turbines of various manufacture. The book contains a profusion of tables, diagrams and illustrations.

4. **Switchgear Installation.** M. Kireyev and A. Kovarsky. *Progress Publishers*, Moscow, 397 pages.

This book is divided principally into two parts, *viz*., Installation of Power System Equipment; and Operation and Maintenance of Station, Sub-station, and Line Equipment. Each part is amply illustrated, and the book is appended by a list of Russian-English transliterations of associated technical terminology.

5. **Elementary Nuclear Theory.** H. A. Bethe and P. Mossison. *John Wiley & Sons, Inc.*, 1956, 274 pages.

Revised and thoroughly updated, this well known book presents the most compact treatment available on the basic theory of nuclear forces, structures, and reactions. The authors have based their explanations almost entirely on the familiar results of non-relativistic quantum theory; and their discussions of experimental ideas are always careful and concise. Containing more than one-half of the text material in the previous edition, the book provides expanded coverage in each chapter and new information on all topics. Much of the additional material reflects the recent extension of nuclear experiments. Some of the new areas treated include the properties of pi-mesons, low energy nuclear scattering, polarized nucleon beams, mirror phenomena with slow neutrons, and high-energy interactions. The book also incorporates recent studies in nuclear size, the latest advances in meson and beta-deca theory, and a new compilation of masses, spins and stabilities of nuclear species.

6. **Development and Exploitation of Oil and Gas Fields.** I. Muravyov, R. Andriasov, Sh. Gimatudinov, G. Govorova and V. Polozkov. *Peace Publishers*, Moscow, 503 pages.

This book sets forth modern scientific knowledge relating to reservoir physics, the theories of development of oil, gas and gas condensate reservoirs, and the technology of oil and gas field exploitation. Considerable attention is paid to the methods of designing oil and gas fields, of maintaining reservoir pressure and of secondary recovery. The topics covered in this book also include the latest trends in the technology of oil and gas well operation and repair, oil and gas gathering systems, storage and utilization of oil and gas. The book is designed as a text book for students of higher oil schools and it is widely used as a practical guide by engineers and technicians of Russian oil fields.

7. **Introduction to the Theory of Probability and Statistics.** N. Arley and R. Buch. *John Wiley & Sons, Inc.*, S 1.65, 1966, 240 pages.

This book is a calculus level text oriented to the physical scientist and engineer. It is intended to give them knowledge of probability and some of its applications which they can use as a basic tool in working out individual problems.

8. **Optical Tooling in Industry.** J. D. McGrae. *Iliffe Books Ltd.*, 35s., 1964, 122 pages.

Optical tooling, the term currently accepted by the aircraft and missile industry, describes the use of optical instruments, accessories, and facilities for the measuring, aligning and inspecting operations performed in industrial manufacturing. Actually, no tooling is involved in any of these operations. The purpose of this book is to present manufacturing and process engineers with a description of what comprises optical tooling, and what it accomplishes. The various optical instruments, accessories, and facilities are presented with the intent of showing how optical tooling supplements and elaborates upon the mechanical methods of measurement used prior to its acceptance by industry. The presentation does not go into specific detail when describing the requirements of an optical tooling installation or the setting and adjusting of the instruments used. It is not intended to be a textbook. Its purposes are: (1) to describe the potentialities of the field of optical measurement, alignment and collimation, (2) to appraise the engineer of the flexibility and range of optical tooling, (3) to indicate the time and cost savings that can be effected by its use, and (4) to present a variety of examples of optical tooling applications.

9. **The Search for Ability—Standardized Testing in Social Perspective.** D. A. Goslin. *John Wiley & Sons, Inc.*, $ 1.45, 1966, 204 pages.

This book is the first in a series of reports on the social consequences of ability testing, for which study was supported by Russell Sage Foundation. The study analyzes the striking change which has taken place in our society during the past half-century in the development and use of ability tests in assigning individuals to positions in society, and in creating opportunities for social mobility. This book will also be of interest to behavioural scientists and psychometricians.

10. **Laboratory Physics: Parts C and D.** *McGraw-Hill Book Co., Inc.*, 1966, 119 pages.

This is the third of the three volumes designed for use in an introductory physics laboratory for students in the physical sciences and engineering. The selection and presentation of material has been made for students who have completed Parts A and B of the Berkeley Physics Laboratory. Begining with a radioactive source and study of the random emission of electrons and photons, this part provides an introduction to statistical physics. Fluctuation in an electron stream and determination of the charge of the electron are also dealt with. Use of photo-emission to detect photons in the visible part of the spectrum has been made, and use is also made of the techniques of a photomultiplier tube for enabling one to observe photon fluctuations and thus enabling computation of the photon-counting rate. These techniques have also been used in a study of the polarization and interference of photons Part D provides an introduction to atomic physics.

261276

PUBLICATIONS RECEIVED

A copy of the publication entitled 'The Automobile Industry of India 1964-65' has been received from the Association of Indian Automobile Manufacturers, Bombay. The publication reviews the positions that the automobile industry and its ancillary industries occupy in the economy of our country today.

A copy of the publication entitled, Proceedings of the Seminar on 'Lead Cable Sheathing' has been received from the Indian Lead Zinc Information Centre, Calcutta. The publication—a special issue (vol. 2, no. 5) of the *Journal of Minerals and Industries, Calcutta,* provides an objective review of the world's latest developments and India's basic economic problems in cable sheathing.

A copy of the publication entitled 'Symposium on Metallurgy of Substitute Ferrous and Non-Ferrous Alloys' has been received from the National Metallurgical Laboratory, Jamshedpur. The publication contains technical papers dealing with the substitute ferrous and non-ferrous alloys.

A copy of the 'Manual on the Subject of Road Transport Laws (Elements)' has been received from the Indian Institute of Road Transport, Bombay. The publication deals with the practical application of complex laws of road transport in its four sections: Motor Vehicles Act—1939, Laws applicable to common carriers, etc., Laws relating to statutory transport undertakings, Elements of Contract Act, etc.

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here.

Shri S. B. Sujan

Shri Shiva Bagomal Suman, B.Sc. (Eng.), M.I.E., died on August 3, 1966. He was a Life Member of the Institution.

Born at Hyderabad (Sind) in October 1902, Shri Sujan completed his general education in Karachi. During the years 1920-23, he studied in Engineering College, Poona. In 1927, he obtained his B.Sc. (Hons.) degree in Civil Engineering from the University of Edinburgh. He then worked as Assistant Engineer in J. C. Gammon, Ltd., on reinforced concrete bridge work at Bhandara, and as Engineer-in-Charge in the Tata Construction Co. on Nander Bridge (Nizam's dominion). During 1928-1958, he served the Concrete Association of India, Bombay, as Assistant Engineer, District Engineer and Regional Engineer. Here, he supervised the construction of concrete roads, etc., in different parts of our country and rendered technical advice on various schemes of concrete construction of bridges, tanks, roads, buildings, causeways, aqueducts, retaining walls, etc.

Shri Sujan joined the Institution as an Associate Member in 1934 and was transferred to Member in 1939. He was also a member of the Committee of the then South India Centre of the Institution.

Shri G. Venkataraman

Shri G. Venkataraman, M.I.E.E., M.I.E., died suddenly at Kothagudium on September 27, 1965, at the age of 55. He was a Life Member of the Institution.

Born in Madras in 1910 Shri Venkataraman passed the Intermediate examination of the Mysore University in 1928. He also passed his diploma examination in electrical and mechanical engineering from the College of Engineering & Technology, Bengal, in 1932. He had his early training in maintenance and repairs of Diesel generating station, E.H.T. transmission and L.T. distribution from the Madura Municipal Electricity Department during 1932-33. After serving several engineering concerns in South India Shri Venkataraman joined the Dalmia Cement Ltd., Dalmiapuram, Madras State, in 1946 as Chief Electrical Engineer. He was responsible for the completion of the extension plan of the Company, installation of two 3,000 kVA transformers, erection of several H.T. and L.T. motors, and laying of E.H.T. and L.T. cables. In 1956 he joined the Singareni Collieries Co., Ltd., as Senior Electrical Engineer, which post he was holding till his death.

Shri Venkataraman joined the Institution as Associate Member in 1953 and was transferred to Member in 1956.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column, a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India) P. O. Box No. 669, Calcutta, except where otherwise stated.

SITUATIONS WANTED

MECHANICAL-CUM-MARINE ENGINEER, having First Class M.O.T. Certificate, aged 28 years, passed Sections A and B of the Institution of Engineers (India), engaged for six years in 9,000 h.p. steam turbine and Diesel engine plant, seeks a suitable job in India. (Office ref. E.S. 246)

ELECTRICAL ENGINEER, B.Sc. (Engg.), Grad. I.E. (India), 25 years, having 2½ years experience in the Transformer Division of a heavy electrical equipment manufacturing concern, of which 1½ years in electrical testing of power and distribution transformers rated upto 5 MVA and 66 kV and electrical maintenance of testing equipments consisting of sinewave synchronous motor alternator set, induction motor alternator set (100 c/s), high voltage testing transformer and other measuring instruments, and the rest in the design and production of transformers rated upto 1500 kVA and 33 kV as general foreman, drawing total monthly emolument of Rs. 650.00, seeks a suitable job of similar nature or sales; prepared to take training in new fields. (Office ref. E.S. 247).

YOUNG ENGINEER, Grad. I.E. (India), having first class degree in Mechanical Engineering with nearly one year experience in project works, stock and storage control and workshops, wants a suitable change in industry; at present drawing Rs. 580.00 per month. (Office ref. E.S. 248).

YOUNG CIVIL ENGINEER, 26 years old, good personality, energetic, passed Sections A and B of A.M.I.E. (India), also diploma holder in Civil Engineering of Madras T.D.E. Board, having an overall experience of six years in surveying, estimating, design and construction of buildings, bridges, roads and R.C.C. works; seeks a suitable change; salary expected Rs. 600 per month. (Office ref. E.S. 249).

YOUNG ENGINEER, L.C.E., First Class, passed Sections A and B of Associate Membership Examinations of the Institution of Engineers (India) with good marks, age 28, having ten years experience in surveying and construction of bridges, buildings and earthwork, and at present working as Inspector of Works (Construction) in the Western Railway, drawing a salary of Rs. 440.00, seeks a suitable change. (Office ref. E.S. 250).

YOUNG MECHANICAL ENGINEER, foreign qualified, having worked in several international firms both in India and abroad, fully conversant with all aspects of engineering, *viz.*, design, development, estimating, sales and production, holding currently a senior position in India, getting around Rs. 2,000 per month, seeks a change to a challenging position anywhere in India. Line of specialization Pressure: Vessels and Boilers. (Office ref. E.S. 251).

CIVIL ENGINEER, 29, passed Sections A and B of the A.M.I.E. examinations, having 6 years experience of which 3 years in responsible position in the construction of tunnels, major bridges, viaducts and earth work; besides, fully conversant with design, drawing, estimating and maintenance works; present salary Rs. 480.00; seeks suitable change in a government undertaking or a private construction company of repute anywhere in India or abroad. (Office ref. E.S. 252).

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	in Parts: Vol. I & II each ...	**Rs.** 11.00
2.	**ENGINEERING DRAWING** by P. N. Vijayvergiya (The book is in Metric system and third angle projection. It contains Mechanical, Geometrical and Building Drawings 2nd edition, 1966)	**Rs.** 12.50
3.	**APPLIED ELECTRICITY** by S. P. Singhal (R.M.K.S. Units) ...	**Rs.** 12.50
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Mysore	No. 3, Vidhana Veedhi, Bangalore-1 (*Telephone 25471*).
Nagpur	North Ambazari Road, Nagpur 1 (*Telephone 5671*).
Orissa	Sachivalaya Marg, Unit IV, Bhubaneswar-1.
Poona	1332 Shivajinagar, Jangli Maharaj Road, Near Shivajinagar Post Office, Poona-5 (*Telephone 57377*).
Punjab	Sector 19A, Chandigarh (*Telephone 418*).
Rajasthan	C-46 Sarojini Marg, C. Scheme, Jaipur (*Telephone 73327*).
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FOOD FROM OIL—PROTEIN FROM PETROLEUM

J. Newell
Non-member

Oil scientists have passed the experimental stages and have succeeded in producing large-scale quantities of high-grade protein, suitable for human diet, from tiny single-celled plants, grown on a diet of almost pure petroleum oil. There is good reason to believe that food grown on petroleum can become an important new source of protein, the essential body-building element in diet. Protein is the type of food which is most gravely deficient in most of the huge areas of the world which suffer from undernourishment or malnourishment today.

Protein from petroleum cannot represent a permanent addition to the world's food supplies, because our planet's resources of oil are limited and will never be replaced. But the fact that oil is exhaustible means that we should be especially careful how we use it, and employing oil as fuel is not necessarily the best way to employ this gift from the prehistory of the earth. For example, it has been proposed that some larger part of the world's oil production should be set aside to be used in plastics production. The long-chain, carbon-based molecules found in crude petroleum, which are used as the basis for some plastics, are extremely difficult and expensive to prepare artificially. Now research has shown that feeding micro-organisms on petroleum is a far more efficient means of producing protein than feeding cows on grass. It is, even, more efficient than feeding on protein which has been extracted directly from plants—another solution which has been put forward over the past few years, to help the world's protein shortage.

Two sets of figures alone show how valuable this new means of obtaining more protein could be. First, research scientists have calculated that 20 million tons of pure protein could be obtained from only 40 million tons of crude petroleum in one year. This would double the present total annual world production of protein. Compare this with other food sources, which have also been suggested as means of bringing about a similar increase, one of the most often quoted being the sea fisheries. At present the world's marine fisheries catch about 40 million tons of edible fish every year. This represents only about 6 million tons of protein, but by tremendous efforts, this might be raised to 100 million tons of fish per year. Any increase beyond that would be likely to bring about decreasing returns, because the reproduction rate of fish would be unable to keep up with depletion. Even this would still only supply an extra 15 million tons of protein a year, less than what could be taken from 40 million tons of petroleum, and it would also involve a much greater effort. In 1962, the world's oil fields produced 1,250 million tons of crude petroleum; 40 million tons is only a small percentage of that.

However, to justify the diversion of even 3% per year of an irreplaceable natural resource to a new purpose, it is necessary to consider whether the need is sufficiently great to warrant it. This is where the second set of figures comes in. By year 2000 A.D. the present world population of about 3,000 million will almost certainly have doubled. The problem of protein shortage, which already affects half the population of the world in various ways, will then become worldwide. To feed that population, not well but at the minimal level required for reasonable health, will require an annual production of 60 million tons of protein.

These two sets of figures, taken together, clearly justify at least large scale research into the production of protein from petroleum, as a matter of some urgency. Such research has already been carried out on a large scale by the British Petroleum Company, one of the world's largest oil companies and which is half owned by the British Government. The Company is supporting a semi-industrial development centre, at Lavera in France, together with a laboratory for fundamental research near Paris and a research and development centre at Grangemouth in Scotland. The British Petroleum Company has also acquired land for an experimental farm in Nigeria, where it hopes to examine the effects of rearing animals on diets supplemented with protein from petroleum, under tropical field conditions. Other oil companies in several countries are now taking up this field of research.

The micro-organism which has proved most suitable for protein production is a form of yeast. When it has been dried and purified it becomes a white powder, with no particular taste or odour of its own, certainly nothing to remind a consumer of its origin, and protein from it can be used in many different ways. The first commercial use is likely to be in feeding livestock, but the scientists have already prepared a number of different versions of the food for human consumption, including tasty meat extracts and strongly flavoured 'fish' sauces which should be popular in Asia. A simpler method of enhancing a protein-deficient diet is simply to add the protein to other dishes as a tasteless powder, and a pure concentrated power suitable for this has been developed.

The research programme has now reached the stage where a large pilot plant is producing protein from petroleum. A number of additional advantages in the process have emerged for instance, experiments on rats have shown that the protein is especially easy to digest. Petroleum protein has been found to have one great advantage over protein taken from plants; it is very rich in a chemical (an amino-acid) called lysine. This is a vital element in human diet and while it is usually common in animal protein it is scarce in protein taken from ordinary vegetables of all types.

Another advantage lies in the fact that, as the yeasts feed on the oil they also perform a valuable industrial function. Crude petroleum is made of a mixture of oils, some of which are much more valuable than others to industry. The favourite diet of the yeasts is that part of the oil which is what chemists call more highly saturated, in other words the fraction which contains more of the element hydrogen, making it harder and waxier. This is the part which the oil engineer wishes to dispose of. Thus a protein-producing plant could also act as a partial purifying plant.

It should be possible, by selective breeding—much easier with simple yeasts than with plants or animals—to produce breeds of yeast which are especially suitable to act as purifying agents. By similar selective breeding it should also be possible to produce a much wider range of different proteins, containing different essential amino-acids, than is possible with more conventional food sources. These proteins could be tailored to supply every conceivable protein nutritional deficiency.

The yeasts can be grown in tanks, and they need no soil, no sunlight, no rainfall and little human labour. Also, being basically vegetables, they will not offend any religious scruples anywhere in the world as a source of protein. But perhaps in the long run the most important advantage of all is that although micro-organisms do grow naturally on petroleum they do so only on a very small scale. Thus, by artificially cultivating them, scientists are creating a new source of food, rather than taking over one which exists already. If, by comparison, they were to attempt to obtain more protein from the similar micro-organisms which live in the sea, then they would be depriving fish of their food and so fisheries would suffer. Protein from petroleum does not interrupt any of nature's food chains in this way.

Petroleum is relatively cheap and stable in price. It can be easily transported by tanker. There are more than 700 oil refineries in the world, distributed through most countries, and in theory protein production units could be set up at any of them. The oil industry already possesses the engineering expertise which would be required, and in general, the industry may be expected to be in favour of the idea, since, by still further diversifying the products of the industry, it would be strengthened.

Most of the facts and figures quoted here are taken from a long article by Alfred Champagnat, the manager of the *Sociéte Internationale de Recherche British Petroleum,* a French adjunct of the British company. Other oil companies are now taking up this field of work, but his unit has blazed the trail.

It may not be many years before the derricks of the Arabian sands begin to provide food as well as petrol.

RECLAMATION OF WASTES FROM INDUSTRIES IN DURGAPUR

P. C. Neogi

Member

Resident Director, The Durgapur Projects Ltd., West Bengal

1. Introduction

In every plant, the process of production is always accompanied by creation of wastes for which, at present, there is no use. These wastes not only cause loss of profit, but often pose serious problems of disposal involving considerable outlay. Maximum reclamation of wastes in major industries is now a subject of intense study and research in advanced countries, and under the compelling necessity for reduction of cost considerable progress has been achieved in this field.

2. Nature of wastes

Wastes arising from industry from different processes may be of bewildering types and composition, but, generally, they are :

(i) In the solid, liquid or gaseous state,

(ii) May contain certain amount of, material in suspension or in solution which can be precipitated,

(iii) May arise at a temperature different from the ambient, thereby offering scope for heat exchange,

(iv) May contain fuel elements and can be burnt for generation of heat, and

(v) May contain elements injurious to plants, animals or structures.

3. Methods of reclamation

The aim of reclamation is maximum utilisation and recovery from wastes, and rendering the final effluent harmless for discharge in land, water, or atmosphere. The processes of reclamation are varied to match the problems of recovery, and often a single type of waste may require successive application of a number of processes for obtaining maximum results. Broadly speaking, the present methods of reclamation can be grouped as under:

(i) Processes for recovery of solids by various methods of precipitation and subsequent beneficiation,

(ii) Processes for utilisation of gas as fuel, or for recovery of by products by cooling, washing and cleaning the gases,

(iii) Processes for conversion of wastes into useful by-products by mechanical and chemical processes by treating the wastes product alone, or in combination with other reagents. Examples are briquetting of swarf, manufacture of slag wool, etc.,

(iv) Processes for recovery of effluents like treatment of industrial and domestic waste water for reuse in the process. This is generally done by various methods of precipitation with prior treatment, and

(v) Processes for immunisation of effluents before discharge, like removal of phenol or corosive and poisonous fluids and gases from effluents to prevent harmful effects on the surroundings after discharge. This is usually achieved by washing or contact with appropriate absorbing material.

4. Durgapur plants

In the past eight years Durgapur has grown into a huge industrial complex, with the following important plants, either in production, or in different stages of construction, and some of them committed to large scale expansion.

(i) Steel Plant

(a) In production	1 million tons per year
(b) Under expansion	1.6 million tons per year
(c) Further proposals for expansion	3.5 million tons per year

(ii) Alloy Steel Plant

(a) Under construction	100,000 tons per year
(b) Future expansion	300,000 tons per year

(iii) Durgapur Coke Ovens and Power Project

Table 1

Project	In production	Under expansion	Further proposals for expansion
Coke Oven, tons per day	1,000	2,000	3,000
Power, MW	210	285	435

(iv) Damodar Valley Corporation (Power Plant)

(a) In production	150 MW
(b) Under expansion	275 MW

(v) Mining and Allied Machinery Project

Under construction and in partial production.
Capacity: 30,000 tons per year.

(vi) A. V. B. Ltd. (For boiler and cement machinery, etc.)
In production. Capacity: 11,000 tons per year.

(vii) *Jessop & Co.* (For cranes, springs and forgings)
Under construction.

(viii) *Fertilizer Plant* (for nitrogen and phosphates)
Under construction. Capacity: 300,000 tons per year.

(ix) *Phillips Carbon & Black Ltd.*
In production.

(x) *Shankey Wheels Ltd.* (For car and truck wheels)
In production. Capacity: about 2,000 units per day.

(xi) *Refractory Plant* (3 plants of small size)
In production of silica and fireclay bricks.

(xii) *Small Engineering Units* (for various finished articles)
Under construction.

(xiii) *Durgapur Chemical Plant*

Under construction for manufacture of:

Caustc soda	... 10,500 tons per year
Phthalic anhydride	... 3,300 tons per year
Synthetic phenol	... 6,600 tons per year

Such excellent rail facilities, road connections, proximity to Calcutta, abundance of power, permanent water supply from the Damodar River Barrage and the existence of a natural drainage system for discharge of effluents are rarely aggregated in one place, and so Durgapur is attracting more and more industries. It started with production of basic materials like pig iron, steel, coke and power, and now processing and by-products plants are being gradually established.

5. The problem of wastes in Durgapur

The problem of industrial wastes due to its variety and magnitude is already serious in Durgapur. But such aggregation of industries in one area is not uncommon in developed countries like Germany, the U.S.A., where fierce competition, urge for profits and in some cases statutory obligations have stimulated rapid advance in the technique for reclamation. A survey of the types of waste and methods of reclamation adopted in each major industry at Durgapur will be made in the following paragraphs to examine what further steps can be taken to improve the present position.

6. The Steel Plant

The operation of a modern, integrated steel plant extends from the mining of the ore to the processing of finished products of various shapes, sizes, and specifications. It is also usual for such plants to manufacture items like coke, oxygen, etc., which are essential for operation of the process Wastes are formed at every stage. Some are reclaimed but the bulk is unutilised as shown below.

(i) ***Mining***

(a) Iron Ore: (Ore fines—50% to 70% of total quarry product.)
These are at present wasted but the steel plant is examin-

ing proposals for beneficiating quarry fines at the mine and then sintering them with flux and coke breeze at the plant for charging in the furnace.

(b) Lime stone: (Fines and low grade material)

These are at present wasted. Fines can be blended with ore fines for sinter and efforts are being made to beneficiate and upgrade low grade lime stones for metallurgical use. This is a crying necessity in view of rather poor proved accessible reserve of higher grade limestone in India.

For 1 ton of pig iron, 1.6 tons of ore and 0.7 tons of limestone are necessary. About the same quantity is now being wasted at the mines at present.

(ii) *Iron making process*

(a) Blast furnace gas: For 1 ton of hot metal, 5 tons or 135,000 c. ft. of blast furnace gas and 180 lb. of flue dust are produced. The gas is cooled, cleaned of flue dust by washing and precipitation and then used as fuel with B.Th.U. value of 80-90 per 100 c. ft. either alone or in combination with coke oven gas in the steel plant. About 100 lb. of iron compounds in flue dust are recovered in thickeners, dried and then can be used with ore fines for sintering. At present they are wasted.

(b) Blast furnace slag: For 1 ton of hot metal, 2 to 3 tons of slag is produced. Its problems will be dealt with later.

(iii) *Steel making process*

(a) Top gases: Composition varies according to different processes, inclusion of Fe-compounds being heavy upto 10% in pneumatic and oxygen process. In Durgapur, no recovery of Fe-compound is being made at present though considerable Fe-loss occurs with exhaust gas during desiliconisation of hot metal.

Top gases in Basic Open Hearth Process at Durgapur are used for raising steam in waste heat boilers, but there is still considerable loss of energy as for input of every 35 therms, per ton of steel production, 9 therms are used for steel melting and 9 therms are utilised in waste heat boiler and the remaining 50% is bled waste.

(b) Steel melting slag: This is about 15% of the weight of steel produced. It will be dealt in detail with blast furnace slag.

(iv) *From rolling*

(a) Mill scales: These are oxides of iron cleaned from the surface of hot ingots and slabs by powerful water jets before rolling. They amount for a loss of about 3% and they are charged back into steel melting furnaces.

(b) End croppings of blooms, billets, etc. to remove pipes and other defects: They may amount to 15-18% of ingot weight, and are usually charged back into steel melting furnaces.

(v) Other waste products

(a) Used refractory bricks from furnace roofs, bottoms and linings: These can be cleaned and partially reused for inferior duties and the rest used for filling material and for construction.

(b) Iron and steel scrap from ladles, skulls and ingot moulds: These are usually charged back into furnaces.

(vi) Auxiliary processes

(a) Coke manufacture: Durgapur steel plant now receives its raw coal, washes part of the coal to reduce the ash content and then blends the raw coal with washed coal and carbonises the same in its own coke oven batteries. The coke is then crushed, screened and fed into the blast furnace. The following wastes arise in the successive stage of production.

(i) From washery: Rejects containing over 35% of ash which are unfit for use in the thermal plant amount to at least 5% of coal charged, and are at present wasted. The possibility of their use for brick burning should be investigated. Present daily raising is about 100 tons.

(ii) From Coke Ovens:

Undersize coke: About 10-12% of the total daily production of about 3,800 tons of run of oven coke is below 20 mm. size and have hardly got any use. A part of 10-20 mm. size is used in power house boiler for steam raising but most of the undersized coke is lying in huge heaps both inside and outside the plant. Efforts so far to find a commercial use for them have not been successful.

Coke oven gas: About 9,500-11,500 c. ft. per ton of coke is produced. After purification it is used as fuel in the steel plant with B.Th.U. value 450-550. An integrated steel plant of 1 million tons per year does not usually have enough use for all its coke oven gas and has an average daily surplus of 5 million c. ft. Unless it is sold to other plants it has to be bled waste. This problem will become more acute with the gradual introduction of basic oxygen process for steel making in future, as there will be reduction in this process of the demand for coke oven gas in steel making.

(b) From oxygen plant: In a modern 1 million ton steel plant, large oxygen units with capacity of about 100 tons per day are installed. In Durgapur, after future expansion to 3.5 million tons, the installed capacity for oxygen will be about 500 tons per day. This will produce 4 times of this tonnage of nitrogen for which there will be insignificant use in heat treating furnaces and the rest will be bled waste. An economic method of utilisation of this nitrogen is a challenge to oxygen industry. As exhaust nitrogen has very low temperature, possibilities of its utilisation for use in cooling the circulating water in power house may be looked into.

(vii) Slag

Slag is a product of combination of flux with impurities in iron ore and ash in coke in iron smelting and with impurities of iron in steel making operations. There are two main categories of slag, *viz.*, (i) blast furnace slag, and (ii) steel melting slag.

Under average Indian conditions, for each ton of pig iron, $\frac{4}{5}$ ton of slag is produced in blast furnace. Quantities of steel melting slag vary widely according to the process but in basic open hearth process, as installed at Durgapur, the amount is about 15% of weight of steel ingots. For 1 million tons of steel for Durgapur Steel Plant, the production of blast furnace slag is about 800,000 tons and steel melting slag 150,000 tons per year.

Only a very small fraction of blast furnace slag is now being reclaimed at Durgapur for use as paving blocks and ballast for road construction, the remainder is accumulating in huge heaps in the slag banks which have to be frequently shifted and extended due to accumulation of tipped material. However, proposals for putting up a slag granulating plant are under consideration.

Steel melting slag from the basic open hearth furnaces of Durgapur is low in phosphorous but contains an appreciable percentage of ferrous compounds as shown in table below:

Table 2

	SiO_2,%	CaO,%	FeO and Fe_2O_3,%	MnO,%	M_gO,%	P_2O_5,%
Runoff slag	11.8	14.8	44	5.4	7.08	2.48
Finish slag	15.5	43.1	13.6	5.4	12.2	4.2

A plant has been established at Durgapur Steel Plant for recovery of furnace scrap from steel melting slag. The slag is crushed, passed over a magnetic belt to separate the iron scrap which is then sized for charging into the steel melting furnaces. The remaining material can be used as road ballast or for filling.

Generally, reclamation of slag is a big problem for the steel plant and very little so far has been done in India for utilization of slag.

7. Alloy Steel Plant

Alloy steel will be produced by melting high grade steel scrap in electric furnace and then rolling and shaping ingots. The main wastes will be from ingot casting and rolling mills, but the scrap will be re-melted in the furnace The old refractories can be cleaned and reused for inferior duties.

8. Durgapur Coke Oven Project and Power House

(i) *Utilization of undersize coke*

The problem of the coke oven is utilization of undersize coke upto 25 mm. size as they are not suitable, either for the foundry, or blast furnace. For 1,000 tons of coke now produced every day, the undersize material amounts to 150 tons and as the capacity is being increased to 3,000 tons per day, the amount will be correspondingly increased.

(ii) *Utilization of ammonia liquor for by-product plant*

The total quantity of ammonia liquor is about 15-25 gallons per ton of coal which is not adequate even after expansion for setting up a concentration plant. The only solution lies in utilizing it in the Durgapur Chemical Factory to produce battery grade ammonia chloride with surplus chlorine from caustic soda plant.

(iii) *Power House*

In the Power House boiler, coal and middlings with 33% ash are being used. With the present installed capacity of 210 MW about 1,800 tons of coal are being consumed giving about 600 tons of ash daily. The disposal of this ash is posing an acute problem of transport and soon all the low lying places in this area will be filled with ash which will ultimately flow down to the main drainage *nullah* serving the entire industrial belt and block it altogether. The problem will increase with the expansion of the capacity of the Plant.

9. D.V.C. Power House

Its present capacity is 150 MW which will soon be expanded to 275 MW and with a similar output of ash every day. This ash is at present discharged ultimately on the upstream side of the Damodar Barrage and is causing heavy silting of the channels.

The problem of fly ash is common and serious for both these power plants

10. Coal Mining Machinery, A.V.B., Shankey Wheels, and other engineering works

Most of the waste consists of scrap from foundries, cuttings and swarf from the machines. While the scrap is recharged in the cupolas, the cuttings and swarf can be collected and profitably briquetted to yield a better price.

11. Phillips Carbon

The visible waste product of this plant, i.e., the thick soot laden smoke from its chimneys is a considerable nuisance to the neighbourhood. A simple solution of the problem, *i.e.*, arresting the soot in an electrostatic precipitator will not only avoid this trouble but will also pay dividend to the firm by helping recovery of pure carbon.

12. Durgapur Chemicals

Although the plant is still under construction, it has disposal problem of about 2.5 tons of chlorine and 80,000 c. ft. of hydrogen every day. While part of the chlorine can be utilized for manufacture of ammonium chloride in combination with ammonia liquor from Durgapur Coke Oven, the ultimate utilization of hydrogen will probably have to be linked with manufacture of compounds in combination of surplus nitrogen in the Steel Plant. This is an urgent field for study.

13. Fertilizer Plant

Construction of a plant for the annual production of 300,000 tons of nitrogenous and phosphate fertilizers is just being taken on hand. While other problems or waste have not yet materialised, it is evident that large quantities of calcium carbonate sludge and also high purity ammonia will be available as surplus. Efforts are being made to use the sludge for manufacture of cement with blast furnace slag clinkers from the Steel Plant. The ammonia may also be used as a valuable ingredient for a separate chemical industry.

14. Common problems

(i) *Recovery of waste water*

Except for the Fertilizer Plant, waste water of all the industries flows down the common *Tamla nullah* to discharge down stream of the barrage. Even during the dry weather the flow in the *nullah* will be 20 cusec. In view of the increasing demand of the water for various industries this water should be collected in settling tanks and after treatment and precipitation of solids, should be discharged into the barrage pond to be available for redistribution. At least 10 million gallons of water should be available in future in this way.

(ii) *Sludge from sewage plant*

Each major plant has got its township and the steel and coke oven project have already got sewage treatment plants in their own colonies. The sludge from the sewage plants and the effluents form very valuable organic manure which is not utilized at present.

These studies indicate that for the following major items of waste in the industries in Durgapur, there are yet no proposals for reclamation.

1. Nitrogen gas	...	about 400 tons per day
2. Steel Plant washery rejects	...	100 tons per day
3. Coke breeze	...	
(a) from Steel Plant	...	400 tons per day
(b) from Durgapur Project	...	150 tons per day
4. Blast furnace slag	...	2,500 tons per day
5. Steel melting slag	...	400 tons per day (after reclamation of scrap)

6. Fly ash from Power Plant of Durgapur Project	...	600 tons per day
7. Waste water	.	20 cusec.

These figures will be increased very considerably when the present and proposed expansion schemes are completed.

16. Wastes posing serious problems of disposal

While all this wastage is causing loss of profit, certain items like coke breeze, blast furnace slag and fly ash from power houses are already posing serious problems of disposal. One has only to look at the mountains of accumulation of these items to realise the urgency for solution. The available free spaces are already heavily committed to provide disposal area and in the next 3 or 4 years no more suitable land will be available for this purpose.

17. Coke breeze

Coke breeze has value both as fuel and also for metallurgical reduction. It can be burnt in special type boilers for raising steam and can also be used in appreciable quantities in sintering ores. If it can be briquetted into 100 mm. cubes it can have wide use in foundries which are at present very short of lump coke. Briquetting is possible either by mixing with a binder and pressing or by mixing it with coal dust, pressing and sintering. Development of an economic and satisfactory briquetting process is an immediate necessity.

18. Blast furnace slag

Blast furnace slag is produced in very large quantities in the Steel Plant. Its properties and various possibilities of its use are indicated below.

Depending on its chemical composition and the physical form in which it is allowed to solidify, three general types are produced, i.e., air-cooled, granulated, and expanded. Of these,

(i) Air cooled slag is produced by pouring the molten slag down the slag bank or into a pit. The slag bank process is usually followed in the steel plants in India;

(ii) Granulated slag can be prepared by three methods, i.e., pit, jet or dry granulation. Of these in the jet process, the stream of molten slag which comes out of the blast furnace tap hole, is broken up by high pressure water jets as it falls into a pit. This method is adopted in production of granulated slag for manufacture of cement and it has been tried by the Tata Iron & Steel Co. Ltd., and it is being extended to some other plants in Hindusthan Steel; and

(iii) Expanded or light weight slag is formed when molten slag is expanded by applying limited quantity of water or with a controlled quantity of water, air or steam.

Typical composition of slag in some of the major plants produced in the U.S.A. and in India is given in the table below:

Table 3

Country	Al_2O_3, %	SiO_2, %	CaO, %	MgO, %
U.S.A.	11.5-20	34-30	51-46	2-2.5
India	25	31	35	5.5

It is important to note that for cement manufacture it is necessary to have MgO under 5% and CaO above 34%, and the ratio

$$\frac{CaO + MgO + \frac{1}{3}\, Al_2O_3}{SiO_2 + \frac{2}{3}\, Al_2O_3} \geqslant 1$$

Air cooled slag: This can be broken up, sized and used extensively as paving material and also as ballast in concrete, roads and tracks. The characteristic rough pitted surface of slag particles and also their hydrophobic nature make them very suitable for bituminous construction. It can also be used for manufacture of slag wool by premelting and blowing high pressure jet of steam in air. It has also use in agriculture to reduce soil acidity, alter and improve physical characteristics of soil and supply essential plant material which soils lack, because slag contains manganese, sulphur, iron, calcium, and magnesium, which are essential for plant growth. Slags to have such use should be that 70% passes through 100 mesh screen.

Granulated slag: The most important use for such slag is manufacture of slag cement. If the slag is of suitable composition, 50% can be converted into granulated slag which is ground and mixed with cement. Such cement has valuable pozzolanic properties.

Expanded slag: Use of this slag making is in light weight structural units for construction and fire proofing and acoustic purposes.

A slag granulation plant which can utilize about 50% of 1 million tons production is going to be established in future. But for effective disposal, blast furnace slag may be utilized in extensive scale in construction. In future, slag should be dumped in pits and chilled by water to facilitate recovery by excavators. It should then be crushed and sized and marketed as a cheaper alternative to quaried stone ballast.

19. Fly ash

The problem of fly ash is more difficult. Its usual analysis is given below:

SiO_2	...	48.0 to 60.7%
CaO	...	1.1 to 3.7%
Al_2O_3	...	23.2 to 27.6%

Approximate sieve analysis is

(a) Below 200 mesh	...	80%
(b) Above 200 mesh	...	20%

So far the following methods of its use have been found:

(i) Due to its pozzolanic properties and fine size, it is possible to substitute it for cement upto 20% in cement mortar where early strength is not required; and

(ii) In combination with lime and some other ingredients it is possible to sinter the mixture and make light weight building blocks.

Utilization of fly ash in a small scale in cement mortar is already being tried in India but its main outlet must be as building material formed by the second process. A plant for this purpose is being set up at Bandel Power House, but the problem at Durgapur is equally urgent and an immediate establishment of similar plant is necessary as otherwise the situation will go out of control.

20. Concluding remarks

The extent of problem of waste and their impact on the economy of Durgapur industries have been indicated in brief outline in the above paragraphs. The search for reclamation demands high priority. However, though frightening in their magnitude, such items are common for similar industries in other advanced countries where continuous research and study have found effective solution. Similar vigorous efforts at Durgapur will be equally rewarding, but no time is to be lost

REPORT ON THE 5TH CONGRESS OF THE FEDERATION INTERNATIONALE DE LA PRECONTRAINTE, PARIS, JUNE 1966

K. F. Antia

Vice-President and Member of the Executive Committee of the FIP

and

Chairman of Prestressed Concrete Group of the
Institution of Engineers (India)

The report is divided into the following 7 sections:

1. General
2. Reports from various countries
3. Technical work by various Commissions
4. Description of Prestressed Concrete work in various countries
5. Research and Development
6. Development of Prestressed Concrete in India
7. New fields for Prestressed Concrete

1. General

.1 The 5th Congress of the Federation Internationale de la Precontrainte (FIP) which took place in Paris in June 1966 was attended by over 2,500 delegates from 55 countries. Twelve members attended from India including the writer as a representative of the Institution of Engineers (India) which is the National body of the FIP and in his capacity as Vice-President for India of the FIP.

.2 At an Administrative Council meeting attended by 21 Vice-Presidents, India was elected to the Executive Committee of 12 members. It was also decided that the member from U.S.A. would take special responsibility for the Americas, the U.S.S.R. member for Eastern Europe, and the Indian member for Asia.

2. Reports from various countries

Reports of the progress in prestressed concrete in various countries were made by Vice-Presidents for these countries. The report covered the gist of the information published in the Indian brochure (*vide* section 6) and the following further data.

If the total prestressing force applied is taken as one of the criteria for the quantum of prestressed concrete construction, the figure for India is 1.4 million tons in a year. This, it is understood, is the fourth highest in the world and gives an indication of the present day progress of prestressed concrete in our country.

3. Technical work by various Commissions

The most important technical work carried out by the FIP was through various commissions investigating specific subjects. Nine commissions presented their reports and synopses of their reports are given below. India was represented on seven out of nine commissions and participated in the work.

.1 *Prestressed lightweight concrete*

The report discusses two types of prestressed lightweight concrete. The first is made with high-quality structural lightweight aggregates such as expanded shales, clays and slates, and is capable of developing cube strengths from 280 to 500 kg. per cm.^{2} at unit weights of 1,400 to 2,000 kg. per m.^{3} Satisfactory values of shrinkage and creep are obtainable. Modulus of elasticity is approximately half that of normal concrete at the same strength. Fire resistance and thermal insulation are significantly better than for normal weight concrete. Specific applications are listed. The second type is cellular concrete, made by foam or gas. This is not prestressed directly, but rather used in composite action with prestressed concrete ribs or slabs. It combines the advantages of low unit weight and high thermal insulation with the structural behaviour and economy of prestressing. It is utilized for roof slabs of dwellings and industrial buildings.

.2 *Prefabrication*

This report is a compilation of thirteen separate sections on items of interest. They are: stressing together of precast units—elimination of mortar or cast concrete joints; self-stressing concrete; extrusion and vibro-stamping—principles and limitations; the electrical heating of high-tensile bars applied to the development of mass production techniques; large units used under water—principles and methods of jointing only; significance of early tension cracks in the compression zone (including the effect of transporting); storage of precast elements, with a note of precautions necessary owing to relaxation, creep and deformation generally; columns—advantages of prestressing; a resume of existing knowledge on shear at the interface in composite construction; precast piles over 30 m. long; an advisory note on the sudden release of pre-tensioned reinforcement; precasting of prestressed bridge beams by casting concrete in forms vibrated from below; poles for power lines; accelerated hardening.

.3 *Prestressed concrete structures in earthquake regions*

In March 1963, a Commission was set up by the FIP to prepare a document on the general principles of prestressed concrete design for structures resistant to earthquake shocks. In the course of this Commission's work it was found that much theoretical and experimental research was still required in order to prepare an international code of practice, and in order to provide immediate assistance to designers the Commission has prepared some provisional regulations dealing with the main aspects of seismic design and construction.

.4 *Application of prestressed concrete to machinery structures*

This report presents the substance of the papers presented at a Symposium held in January 1964 at Wexham Springs. The principal subjects discussed were: power stations; dynamic loading; some structures subject to shock loading; foundations for heavy plant; presses and plant for heavy metal-cutting. triaxially prestressed bedplates for heavy frames. It was concluded that the characteristics of prestressed concrete were suitable for machinery frameworks.

.5 *Prestressed concrete fuel-oil and petrol tanks*

This report presents a survey of tanks already built and gives recommendations for the future development and construction of prestressed concrete fuel-oil and petrol tanks. A bibliography of books and papers on the subject is included as well as a summary of the main features of 213 tanks built since 1939. Methods of achieving impervious tanks are discussed and there follows a general comment on the safety aspects of such tanks. Economic considerations are discussed although no direct comparison is drawn between prestressed concrete and any other material. The report does not try to establish specifications for the design and construction of fuel-oil tanks but rather to realize that there are several standard solutions to each problem and to present these under the general headings of the tank floor, the base joint, the wall and prestressing of the wall. A guide to the considerations necessary when deliberating whether or not to construct in prestressed concrete is given and the relative advantages and disadvantages of prestressed concrete tanks are listed.

.6 *Methods of achieving high-strength concrete*

This report deals with concrete having compressive strengths (measured on cube or cylinder) greater than 1,000 kg. cm.^{2} Ways of achieving this examined: improved compaction; improved paste-aggregate bond; the application of triaxial stress; the inhibition of crack propagation. Methods ready for practical use and methods requiring further development are appraised separately. A note on costs is followed by comments on the characteristics and uses of high-strength concrete.

.7 *Corrosion problems with prestressed concrete*

The report summarizes the present position as regards corrosion of prestressing steel and is based on the papers and discussion of a Working Group reported at a symposium held from September 6 to 9, 1965. The topic is discussed under three main headings—pitting corrosion, inter-crystalline stress corrosion, and hydrogen embrittlement—and the results are related to the history of the steel, its surface condition, the amount of cover, and the type of aggression.

.8 *Free resistance of prestressed concrete*

At a meeting in June 1965, experiences in this field were exchanged between representatives of 12 countries. It was found that, whilst there was a tremendous fund of knowledge, it was all based on different testing standards and techniques. The first task of the Commission for the future will therefore be to establish a standard form of test and to establish uniformity in techniques in all laboratories to ensure that results are interchangeable. The conclusion reached by the meeting was that prestressed concrete is a highly desirable material for buildings that may be subjected to a fire hazard.

.9 *Practical recommendations for the design and construction of prestressed concrete structures*

This report outlines the work of the joint FIP-CEB Committee from its inception in the summer of 1962 to the recent publication of its provisional recommendations on the lines of those already published for reinforced concrete. The same principles are adopted, namely the use of 'limit states' which define the critical conditions which could put a structure out of use and the inclusion of the semi-probabilistic criterion of safety. The report discusses these approaches and shows how they have been extended to cover prestressed concrete.

4. Description of prestressed concrete work in various countries

.1 Outstanding structures in prestressed concrete were presented in illustrated brochures by various countries. It is gathered from these brochures that prestressed concrete is being used for almost every type of structure including bridges, viaducts, industrial, office and residential buildings, theatres, stadia, warehouses, factories, schools, markets, roads, airfields, tunnels, jetties, dams, irrigation structures, reservoirs, water towers, silos, bunkers, gantries, and pressure vessels.

.2 Prestressed concrete is being used most extensively in bridges, viaducts and grade separation of roads, and its most sophisticated use is in pressure vessels for atomic power stations. The longest bridge in India, the Sone Bridge (over 3,000 m.) as well as the longest bridge in Europe, namely the Eastern Scheldt Bridge (5,022 m.) are both built in prestressed concrete.

.3 Considerable development work is in hand on the design and construction of prestressed concrete pressure vessels for nuclear reactors.

.4 The introduction to the brochure prepared for India is given in section 6.

5. Research and development

.1 The emphasis on research in prestressed concrete is changing from the initial concepts of the elastic behaviour of members and the problems associated with the mechanics of prestressing to the fundamental study of the complete behaviour of members at all stages of loading in both the linear and the non-linear ranges.

.2 The most extensive research is at present being conducted on prestressed concrete in pressure vessels for nuclear reactors at power stations. This includes (i) the analysis of the loading and temperature effects in thick shelled structures, (ii) stress concentration problems particularly in the pile cap area due to a large number of penetrations because of the complex mechanical requirements in such vessels, and (iii) a study of the properties of concrete and steel at elevated temperatures over long periods of time and under irradiation conditions.

.3 Research on prestressed concrete bridges covers (i) Effects of creep, shrinkage and thermal movement in recently built bridges, (ii) use of model analysis and testing as a design tool, (iii) Shear connectors for composite bridges, and (iv) Freyssinet type hinge for bridge supports.

Bridge beams are also being standardised both in I and in box sections upto about 36 m.

.4 Some of the other items of research are (i) Ultimate flexural strength, differential shrinkage and shear at the interface of composite sections, (ii) Behaviour of end blocks in prestressed concrete members, (iii) Effect of grout properties on structural behaviour of beams, (iv) Flexural strength of ungrouted beams, (v) Stress corrosion, (vi) Tensile stress in prestressed concrete beams, (vii) Stability of prestressed concrete beams during handling and in service, and (viii) Thermal effects in prestressed concrete.

6. Development of prestressed concrete in India

Prestressed concrete may be considered to have been introduced in India in 1949 in the shape of girders for railway bridges. The way in which these prestressed concrete girders came to be built is interesting. A railway line was under construction in the state of Assam in 1948 and there was a considerable shortage of steel during that period. Ways and means were therefore explored to find some substitute material for fabricating the girders of a number of bridges on this railway. Girders of timber were not considered suitable because of the fire hazard, and aluminium was even more scarce than steel. Consideration was the refore given to the possibilities of adopting prestressed concrete girders and even though literature on the subject was meagre, the girders were designed with available data. In order to ensure that such girders would withstand the heavy dynamic loading to which they would be subjected in service, full scale tests were carried out on a test girder. For this purpose, a 13 m.-span was designed for a metre gauge railway and for vehicles with 14-ton axle loads, and this was subjected to dynamic loading of vehicles with 23-ton axle loads pertaining to a broad gauge (1.676 m.) railway. The girders were tested for speed upto 100 km. per hour. On the full scale test proving successful, a number of spans were built on the railway in Assam which are still in service. The girders on the Assam railway are considered to be the first prestressed concrete girders in the world built for railway loading.

There was subsequently a hiatus of about four years because of several inhibiting factors such as non-availability of high tensile steel wires. A road bridge was then taken up for construction with prestressed concrete girders. This was in 1953. The bridge has 23 spans of 27 m. each, but before it was constructed a full scale span was again tested to destruction. The results were eminently satisfactory. The completion of this bridge in the state of Madras led to the construction of several road bridges in prestressed concrete all over the country.

In view of the continuing shortage of steel and the comparative economy of prestressed concrete, the construction of bridges in prestressed concrete proceeded rapidly in subsequent years and by 1962, over 600 spans of road bridges with maximum span upto 48 m. were in existence. Prestressed concrete was also used extensively for railway bridges and over 600 spans were completed during the same period, but the maximum span was restricted to 18 m.

The use of prestressed concrete in structures was introduced at a later stage. Progress was hindered for some years because of high tensile steel wire not being manufactured in India and foreign exchange being restricted for its import. This shortcoming was, however, made good recently by plants for the manufacture of high tensile steel wire coming into existence in the country. High tensile steel billets for the manufacture of the wires had, however, still to be imported until very recently. Their manufacture has now been undertaken in the country, and it may well be expected that this will result in a further rapid advance in prestressed concrete construction in India.

Most of the systems of prestressing and anchoring prevailing in the Western countries have been adopted in India, together with one or two indigenous systems.

In 1953, a number of enthusiastic engineers formed a Prestressed Concrete Development Group under the auspices of the Institution of Engineers (India) which has a membership of over 66,000 engineers and students. Affiliation with the Federation Internationale de la Precontrainte followed, and the Institution of Engineers is now the National body of the FIP in India.

Considerable progress has been made in the design and construction of prestressed concrete in India since the last congress of the FIP in Rome in 1962 and road bridges with spans upto 120 m. are under construction. The method adopted for the construction of such spans is the cantilever system which was first used for the bridge over the Rhine at Worms, in Germany. Spans upto about 50 m. are in many cases launched with the help of launching girders of aluminium or steel.

A large variety of structures other than bridges are now being constructed in prestressed concrete and include silos for storing fertilizers, syphons for conveying water across large depressions, jetties, structures in steel plants, hangers, structures for electric sub-stations, and water storage tanks of cylindrical and spherical shapes.

7. New fields for prestressed concrete

Brief notes are given on some structures which may be considered to open new fields for prestressed concrete.

.1 *Pressure vessels for nuclear power reactors*

Prestressed concrete has been chosen as the most suitable material for the pressure vessels, since this makes possible the design of an efficient structure large enough to accommodate a reactor design in which the core and the boilers are contained within a single pressure envelope.

The behaviour of a prestressed concrete pressure vessel can be closely predicted up to failure and enhances the safety of the reactor system.

Gas tightness of the pressure vessel is provided by a liner of ¾ in. thick boiler quality steel plate.

The most suitable shape has been found to be a sphere.

Since the construction of a spherical outer surface would be complicated and costly, theoretical and experimental studies have been made of designs in which the void was spherical and the external surface formed by plane horizontal and vertical surfaces approximating to a series of concentric cylinders. Sixteen vertical ribs were added to the outside surface to carry circumferential prestressing tendons and anchorages. The behaviour of this composite shape has proved to be very close to that of a uniform sphere and is modified external geometry brought a number of practical advantages.

The largest nuclear power station in the world is under construction at Wylfa in Britain and will have an output of 1,180 MW.

The thickness of the concrete vessel wall is 11 ft. at the bottom can pole, and at the equator. The top of the vessel is 12" thicker than the bottom cap.

The ribs are generally 8 ft. wide, and project 8 ft. from the face of the vessel.

Prestressing of the concrete pressure vessel is achieved using a special 36/0.6 in. strand prestressing system which provides force at transfer of 600 tons.

The minimum ultimate load factor of the Wylfa vessel is 2.65. The load factor of penetration closures is greater than that of the main vessel so that the prior failure of these can be considered inconceivable.

The spherical vessel behaves substantially as a membrane structure under ultimate load conditions, and there is no significant change in its mode of behaviour between working and ultimate load.

The minimum concrete strength at 56 days is 6,000 lb. per sq. in. and the minimum strand strength of 51,000 lb. per strand.

The analysis of the vessel is based on flexibility methods of analysis for statically indeterminate structures. The vessel is divided into convenient statically determinate elements. The deformation of the elements at their common boundaries caused by known applied loads is equated to the deformations at the same positions due to unknown continuity forces. Solution of the resulting simultaneous equations gives the contnuity forces. The continuity forces and statically determinate loads can then be combined to give a direct load, moment and shear force at each boundary so enabling the stresses at these sections to be determined.

The structural calculations take account of the geometrical shapes of the vessel, the actual arrangement of prestressing tendons, the effective decrease in elastic modulus, temperature regimes, dead loads and construction loads, prestressing losses in tendons, relative shrinkage, and internal pressure. Due to the number of elements which must be used in the analysis a considerable amount of computation is required to obtain solutions for the many alternative combinations of circumstances which must be considered. A computer has been used to carry out the analysis.

The design was evolved after extensive programme of research and development. On the one hand methods of design and analysis were developed making full use of modern computer techniques. On the other hand a comprehensive research programme was undertaken embracing both cylindrical and spherical vessels.

2 *An integrated urban sector project in Montreal, Canada*

An integrated urban sector project incorporates into a single three-dimensional complex housing, commercial development as well as institutional and recreational facilities.

It is a building system utilising precast post tensioned concrete as the major building material. As a building system, it is based on the principle of the grouping of several standardized modular elements within a structure.

Modular house units, pedestrian street sections (girders), vertical stairs and elevator shafts are all precast and connected to each other to form a structural whole.

Mass production is also introduced in the house finishing where components are installed into the precast units in the assembly line.

The project consists of 354 modular construction units comprising 158 housing units. A network of parks and playgrounds surrounds the project.

The construction system consists of the precasting of large three dimensional modular units. These box-like elements measure 17 ft. 6 in. × 38 ft. 6 in. × 10 ft. high. Kitchens, bathrooms, window frames, insulation, etc. are all installed into the box unit which is then ready for section. The weight of the boxes varies from 70 to 90 tons at the time of lifting.

In grouping the units, gardens are formed on the roof of the unit below, (the large ones measuring 17 ft. × 36 ft.). All house have at least one garden, and the large houses have two gardens.

The modular units are load bearing. They are erected one on top of the other, carrying the major part of the load through walls and piers.

3 *Immersion method of tunnel construction in Holland*

The 'shield method' which is often used elsewhere for tunnel construction cannot be used in Holland where the country is low and this, combined with the fairly high groundwater level, presents extra problems.

The increase in ocean-going shipping in the main waterways and the growing land traffic which crosses these waterways have augmented the need for underwater tunnels. The 'immersion method', developed in about 1930, is looked upon as a very suitable one for tunnel construction under Dutch conditions.

Prestressing tendons are temporarily applied to make it possible for the elements, which consist of sections joined by a flexible connection, to be transported floating and then immersed, after which the tendons are released and removed. Only certain elements of the tunnel have permanent prestressing.

In order to limit effect of temperatures each element is made up of five sections (18.6 m. long) in case of one tunnel. The haunched joints are provided with water stops and the entire tunnels covered with a bituminous members. Such flexible connections have also a favourable effect in the event of unequal settlements. To make it possible for an element of 93 m long (net weight about 16,000 tons) to be transported—after being made to float by means of water-tight end walls—and subsequently be immersed (by filling built-in water tanks), it is temporarily prestressed longitudinally with 92 cables.

When it is immersed, the element is pushed close against the one placed previously, in such a way that a special rubber profile along the outer edge of the end wall ensures a perfectly water-tight seal. The space between the two end walls is then pumped dry, whereupon the pressure of the water against the other end wall forces the new element against the previous one. They can then be coupled. The longitudinal cables are then released and removed.

4 *Concrete suspension bridge in Canada*

In remote areas, a method of rapid construction of bridges of the concrete suspension type has been evolved in Canada, and Hudson Hope Bridge in British Columbia has been built by this method.

The idea is that of precasting an entire bridge deck in short segments at the site, hanging these heavy segments from a cable suspension system, and then post-tensioning the entire deck span.

16 concrete multicell box girder segments were precast on each side of the river. Each is 37 ft. wide 20 ft. long, 4 ft. deep and weight 90 tons. They serve as both roadway deck and stiffening element.

The precast segment was raised from its casting bed on the river bank, transferred to a low-bed trailer truck and driven to the river side of the tower. From this point, a sling from a specially constructed cable traveller that rods the main bridge cables lifted the precast segment from the truck with the aid of which lines from both shores. The load was lifted up toward 2 pairs of suspender cable clamps and the load was then transferred from the sling to the suspenders. The cable traveller was then winched down the main cables and the segment was transferred to the next set of suspenders. And so on from suspender point to suspender point until the segment its proper position on the bridge.

The entire 32 precast 90 ton segment were put into position in only 10 working days. The closing segments at each end of the bridge were then cast in place, and the entire deck was post-tensioned longitudinally with an applied force of 101,000 lbs. per 1¼ in. diameter galvanized strand.

The entire bridge structure took about 9 working months to complete, with an average crew of about 50 men.

5 *Longest concrete arch span in the world*

The longest concrete arch span in the world is in Gladsville Bridge at Sydney Australia, with an arch span of 1,000 ft.

It consists of four Voussoir arches, made up of a series of precast hollow arch blocks. These were hoisted to the crown of the false work, placed on rail trolleys and moved by gravity to their correct positions in the arch—which was allowed to grom uniformly from each abutment. Joints between blocks were 3 in. *in-situ* concrete. After joining all units the completed arch was de-centred by jacking with four layers of Freyssinet flat jacks at each of the two quarter points.

To provide additional stability, partially stressed strands were located between the arch ribs longitudinally and the arch stressed transversely through diaphragms at 50 ft. centres.

The prestressed concrete beams, carrying the roadway are carried on piers supported by the arch and each pier is made up of two slender prestressed columns carrying a reinforced concrete crosshead. The space between the beam flanges is filled with compositely acting *in situ* concrete. There is no additional concrete pour over the beam uanges. Beams are made continuous under live loading, by overlapping in an *in situ* pour, reinforcement left projecting from the beam ends.

THE ROLE OF FARMERS IN SOIL CONSERVATION

A. K. Mitra
Graduate
Sub-Divisional Officer, Kakdwip Irrigation Sub-Division,
Government of West Bengal

Introduction

Soil conservation in general, means an effective maintenance of the productive capacity of the land on a permanent basis, and this can not be possible unless due consideration is given to the economic and social condition of the farming people.

The planning and operation of a programme designed to conserve land and put it to its most effective use in terms of the welfare of the people, is actually a difficult task, specially, under Indian conditions. At the present moment, to start with the subject under discussion, it will be much better to understand the present economic and physical factors first on which the conservation of soil mostly depends.

Economics and means

Considering the economic status of the farming people today, it may be mentioned without the least hesitation that the cultivators, these days, have been practically impoverished in our country. A little knowledge of economics will suggest that where the economy is industrial, huge population can be maintained in mills and factories, and hence in that case less attention will be paid to agriculture. This principle holds good in all parts of the world other than in India where we find that it assumes somewhat a different outlook. In our country, more than 80% of the people are villagers, living on agriculture mostly. So, it naturally brings inspiration in our mind that we should always keep a careful watch over what is being done by our farmers in connection with the conservation of soil of our land. As a matter of fact, we find that the problem of finance is really acute in India so far as the case of farmers are concerned, and it is therefore expected that whatever the farmers should do for the conservation of soil, should be in keeping with the minimum possible expenditure. The farmers should raise some fund by making small contribution and then utilise the same in doing works for the conservation of soil in a cooperative basis. The works of the farmers in such a fashion will adjust their economic problems to a great extent. Out of the several works that are to be done by the farmers in connection with the conservation of soil where they have to spend not even a penny, their role in afforestation of uncultivable lands seems to be a very important one. Barren lands are of no use, simply they help in the erosion of soil. So, by allowing forests to grow over the same, conservation of soil can be made possible. Indiscriminate burning of forest products and also burning of dried vegetation below *Mahua* trees for collection of fruits in the parching weather, helps in eroding the bare areas in the first monsoon. The farmers should stop it right now. Due to continuous and uncontrolled grazing, there is practically no vegetation in villages to graze upon. Even cropped areas after harvesting, are used for grazing, thereby loosening the soil and helping the same to get washed in the first flush of the rains. The farmers can allocate a suitable portion of their holdings as grasslands to check the same. Such allocation of grassland may rotate in turn, over every plot after a suitable period to minimize the reduction of soil productivity by repeated ploughing. Retirement of over cultivated lands also, should be made through permanent protection of grass and trees. Lands, which are unfit for herbage, say, sandy lands or sand dunes, may be used for growing suitable kind of grasses like *Munj, Sarkand, Jhalas,* etc., extensively used in Bihar State, and production of Ipomoea creeper in West Bengal which mostly thrive better on sand and which, from the economic point of view, may be used for thatching if not for fodder. This costs almost nothing to the farmers. *Munj,* etc., will be more useful for areas in South Bihar where rivers have spilled on both banks during floods. Apart from this, there are lands for common use, making wide passages, better known as *'Gaer Mazrua Am'* or *'Chaur'* (known in Bihar) connecting villages which are mostly barren, may be used for intensive tree plantation. This will solve fuel problem to a great extent, and the cowdung will then go for the conservation of soil.

Modern agronomy

Apart from the economic conditions, the physical factors on which the soil conservation mainly depends, seem to be of more importance. It will not be out of place to mention that there are several reasons due to which the fertility of our land has considerably decreased. The age old method of cultivation is giving very low yields, the average outturn of most of our important crops is abnormally low as compared to others in the world. The uncontrolled freak of rains and prolonged draught have been responsible for damaging large number of plant families. Adequate irrigation facilities are not available in our country. It has been estimated that 90% of our agriculture is dependent on the whims of the monsoon, and the fertility of the land under crop production could not, therefore, advance. Naturally, rain being the only source of irrigation, the method of single cropping is still persisting in our country with its inherent disadvantages. What should be done by the farmers actually is, that they should give up completely their old knowledge of agronomy, and should concrete their minds towards the moredn techniques developed by scientific researches. The holdings should be bigger in area and with proper field-ridges so that rain water may not flow from one holding to another. This will save sufficient productivity of the soil. Double or triple crop agriculture should be practised as far as possible so that the conservation of soil can be possible. Root crops (*i.e.*, red potato, ground nuts, raddishes) are to be discouraged as they loosen the soil while uprooting the crop. The farmers may, on their soil, grow crops alternately as this requires repeated intertillage than the spreading cops, requiring practically little or no intertillage. On sloping grounds, the farmers should adopt strip cropping combined with terracing. The natural calamities over which, one has little control, things like insect attack and plant disease should be carefully observed by the farmers and action should be taken accordingly for immediate remedy.

Soil erosion

For the checking of soil erosion, a dense population upto a limit, which the land can support, is indeed the best insurance against the forces causing erosion. The high density of population give every acre of land a national value, and hence farmers, more in number, shall concentrate overlimited holdings. Where cropping is intensive, the holdings shall be restricted to not more than four hundred acres of land. The conservation of our soil is of paramount importance in our agricultural economy, and considering the vastness of the problem, the best plan under this circumstance, for the farmers, should be to tackle small water-sheds in different regions as a suitable unit to start with, in controlling and reducing damage from floods or siltation. Erosion in small water channels may be checked by the farmers by allowing to grow thorny bushes on their beds at suitable intervals. The aggregate results of these water channels as a whole in reducing damage from floods, will be an example for the farmers to understand the importance of soil conservation measures.

Moreover, the cultivators should provide for small earthen dams near the cultivable lands like *'aharas'* (known in Bihar State) so that rain water may be accumulated and thus conservation of soil can be made possible. Farmers should pay more attention to the repairs and protection of field ridges and existing earthen bunds in the early monsoon, when there is practically no vegetable cover on them. Dry farming, in low rainfall areas, on slopy lands should be encouraged by the farmers. It has already been mentioned that in our country, the farmers are poor, and as such all these works are expected to be done without incurring a penny. Streams and brooklets carrying silt are to be bunded up so that there may not be any further erosion of soil.

Conclusion

It will be worth suggesting that the farmers should make their earnest efforts in achieving success in their labour in connection with the conservation of soil by *Shramdan* as already done in Kosi and other community projects in Bihar, and also by contributing in a cooperative basis, for taking immediate measures towards soil conservation. In the words of our Late Prime Minister Lal Bahadur Shastri, 'It is the farmers on whom the Indian economy and progress depend'.

THE SPEECH DELIVERED BY H.R.H. THE PRINCE PHILIP, K.G., K.T., THE DUKE OF EDINBURGH, ON THE OCCASION OF THE COUNCIL OF ENGINEERING INSTITUTIONS' BANQUET TO WELCOME DELEGATES TO THE COMMONWEALTH ENGINEERING CONFERENCE, LONDON, MAY 18, 1966[*]

I am quite sure that all the overseas visitors here this evening know how welcome they are already, but even so, I want to emphasise how delighted the Council of Engineering Institutions and its members are to be able to entertain the Commonwealth delegates to the Commonwealth Engineering Conference.

I think it's only fair to add that we are also delighted to welcome the British delegates to the conference as well as all our other guests.

Having bid you all welcome, I in my turn, must revert to being a guest, and on behalf of everyone here offer our thanks and appreciation to the Master and Wardens for allowing us to use their lovely hall this evening.

The Council, as you know, is a relatively recent creation, but I think it is destined to play an increasingly important part in the future development of all branches of engineering in this country. As President I am naturally very happy that you have decided to accept delegates from the Council at future conferences.

This evening I particularly want to welcome the delegations from Zambia, East Africa, Trinidad, and Tobago. I hope this will be the first of many conferences they will be able to attend.[†]

There are many views about Commonwealth and international conferences. Some think there are too many of them, and that they take up too much time; some are anxious about the weight they put on at all the lunches and dinners, others think they are a total waste of time, others again invest them with an importance and value far beyond their due. Everyone here, of course, has a perfectly balanced view of their importance, —or, you would'nt be here at all.

My experience of international conferences is not very wide, but apart from the purely professional value, which I am not able to judge, I would say that the personal contacts and relationships which develop during a conference often have a very profound influence on the individuals concerned.

I would also suggest that international meetings of professionals with a common interest have a far greater political significance than many so-called good-will conferences, and are usually conducted in a rather more peaceful, if not more friendly atmosphere, than many international sporting encounters. Professional people carry a good deal of weight in the community, and their knowledge, respect, and understanding of their fellow professionals in other countries will certainly influence their outlook and general opinions.

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[*] H. R. H. The Duke of Edinburgh is the President of the Council of Engineering Institutions, U.K.

[†] Zambia, East Africa, Trinidad, and Tobago are new entrants to the Commonwealth Engineering Conference.

It's true I'm assuming that you only meet nice respectable people on these occasions, and I hope the reverse is the exception.

I must confess that I am a great believer in Commonwealth conferences of all kinds, not for any political reason, and not even as a means to keep the Commonwealth together. I believe that the members of the Commonwealth have two vital assets which should be exploited to the fullest extent for the benefit of all members. We have a common language. It's true that for some it is the first language, and for others it is their second. But, it provides a means of quick and direct communication which seldom exists at international meetings.

Secondly, so many of our institutions and the framework of so much of our lives, in education, the professions, and government practice, are basically similar. People hold comparable jobs, have comparable responsibilities, and hold positions which are immediately recognisable by their description or title.

This puts members of the Commonwealth in a unique position to learn from each other, and to make use of each other's experience quickly and easily. It is seldom necessary to make more than minor changes in order to adapt new practices and ideas to home conditions.

The particular importance of this conference is that the fastest growing industries are the science-based industries, and their products provide the fastest growing element in world trade. Quite naturally, there is an increasing demand for engineers to satisfy this growth. But, the need is not for any engineer, the need is for engineers with the right training, and the right specialised qualifications. And in my opinion, these qualifications should include at least an understanding of management problems and techniques. Management and technology cannot be separated with any hopes of success.

The relative inefficiency of a large part of British manufacturing industry at the moment—I am basing this rather sweeping statement on some figures recently published which show that sales per employee are as low as 50% of their American equivalents—(and I realise that this) is due to a number of causes, but I suspect that one important cause is the lack of engineers in management, and the lack of management training in engineers.

In the wider picture, every country in the world is crying out for technological development. To meet this need three conditions are absolutely essential. In the first place, there should be the greatest freedom of movement for all qualified engineers and technicians between countries, provided of course this does not imply any reduction in standard. Restrictive practices frequently seem desirable in particular cases, but this case is much too important for the welfare of all mankind, to justify a sectional outlook.

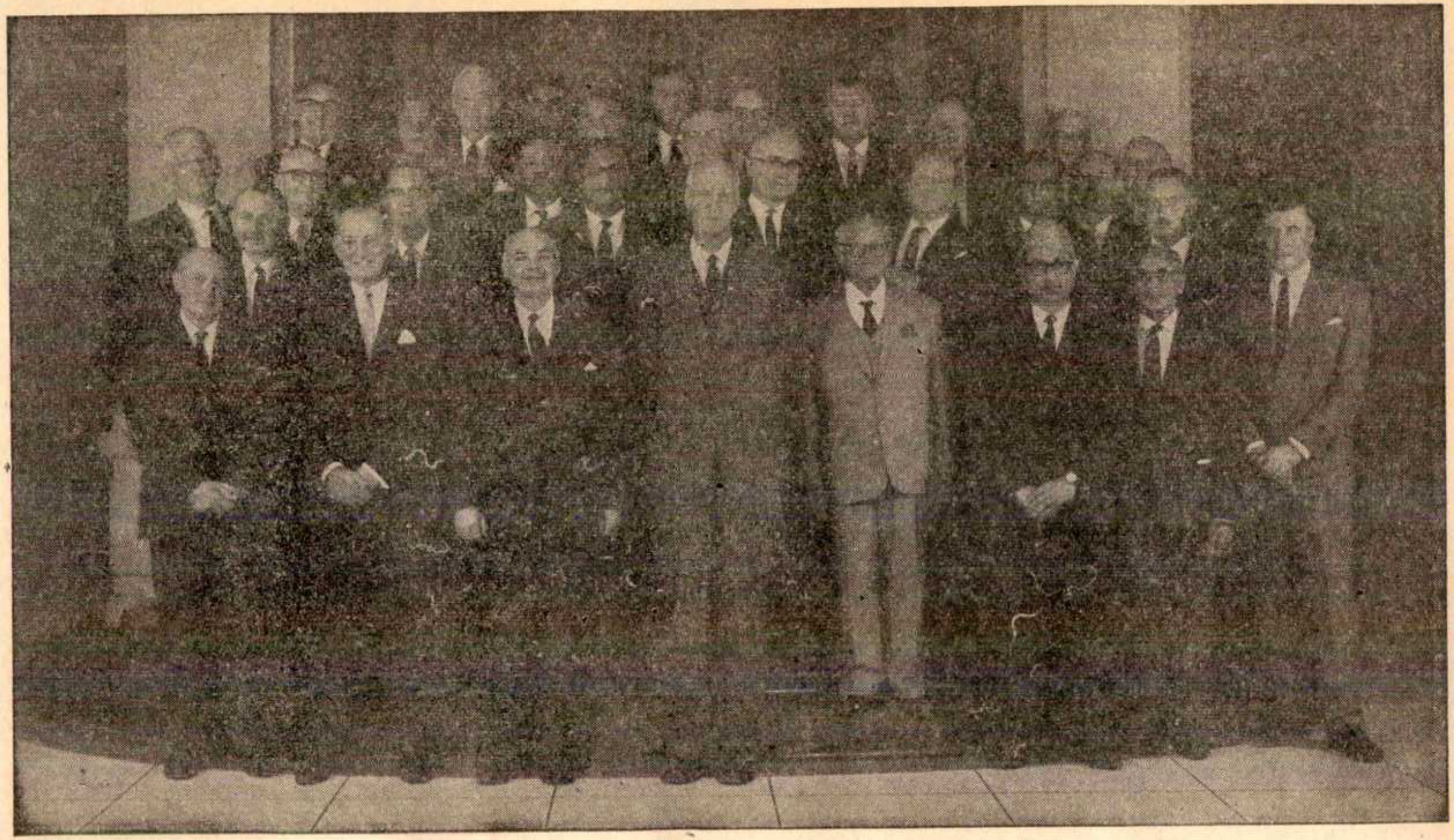
Secondly, there must be adequate training facilities and qualifications available for all levels of engineers from operatives right through to graduates and Fellows. Within the structure, there should also be complete freedom of movement up the ladder of qualification. No one should be required to stick at any particular level, if he is able to qualify for the next higher.

Thirdly, the problem of bringing the fruits of technology to the people who need them is not entirely technical. It demands a lot of judgment and human understanding and the development of these faculties should also find adequate space in the educational system.

I realise I am, probably, speaking to the converted, but I want to be on record in support of the work and aims of the Commonwealth Engineering Conference.

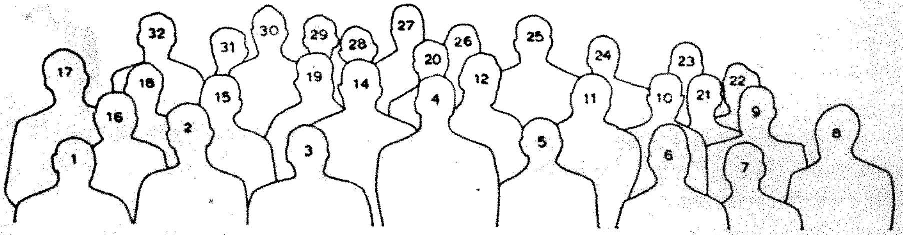
It is going to be some years before the Conference meets again, so that the toast to the guests has got to be rather more effective than usual.

All the guests are welcome here this evening, for themselves, for the work they are doing for the Conference, and not least for the valuable contribution they are making to the welfare and progress of mankind in their work as engineers.'



Delegates to the Sixth Meeting of the Commonwealth Engineering Conference, London, May 9-20, 1966

Key to group photograph of delegates



1. Mr. E. J. Crawford, *President, Institution of Engineers, Australia*
2. Mr. C. H. D. Harper, *Secretary, Institution of Engineers, Australia*
3. Dr. Gaetan Cote, *President, Engineering Institute of Canada*
4. Lord Hinton of Bankside, *President, Institution of Mechanical Engineers (Conference Chairman)*
5. Mr. B. P. Kapadia, *President, Institution of Engineers (India)*
6. Maj. Muhammad Salim Khan, *Delegate, Institution of Engineers, Pakistan*
7. Mr. C. A. R. Anketell, *Delegate, Institution of Engineers, Ceylon*
8. Mr. K. G. Stevens, *Past President, Rhodesian Institution of Engineers*
9. Mr. F. Jackson, *Immediate Past President, South African Institution of Civil Engineers*
10. Mr. R. N. Banerjee, *Secretary, Institution of Engineers (India)*
11. Mr. Garnet T. Page, *Secretary, Engineering Institute of Canada*
12. Dr. G. F. Gainsborough, *Secretary, Institution of Electrical Engineers, and Secretary, Conference Executive Committee*
14. Mr. S. Sarda, *Member of Council, East African Institution of Engineers*
15. Mr. Thean Lip Thong, *President, Institution of Engineers (Malaysia)*
16. Dr. J. B. Brennan, *Secretary, Institution of Chemical Engineers*
17. Lt.-Col. H. R. Bridger, *Past President, East African Institution of Engineers*
18. Sir Arnold Lindley, *Vice-President, Institution of Mechanical Engineers*
19. Mr. R. Rozario, *Secretary, Institution of Engineers (Malaysia)*
20. Mr. J. A. Banks, *President, Institution of Civil Engineers*
21. Mr. Eric Boden, *Manager, Associated Scientific and Technical Societies of South Africa*
22. Mr. F. Jervis Smith, *Conference Secretariat (Deputy Secretary, Institution of Electrical Engineers)*
23. Mr. D. A. Harris, *Deputy Secretary, Institution of Civil Engineers*
24. Sir Robert Wynne-Edwards, *Chairman, Council of Engineering Institutions*
25. Professor H. J. Hopkins, *President, New Zealand Institution of Engineers*
26. Mr. R. W. K. Stevens, *Secretary, New Zealand Institution of Engineers*
27. Brig. J. R. G. Finch, *Secretary, Council of Engineering Institutions*
28. Mr. L. Drucquer, *President, Institution of Electrical Engineers*
29. Mr. J. M. Buchan, *Secretary, Engineering Institution of Zambia*
30. Mr. J. E. Mitchell, *President, Engineering Institution of Zambia*
31. Mr. K. H. Platt, *Secretary, Institution of Mechanical Engineers*
32. Mr. F. E. Warner, *President, Institution of Chemical Engineers*

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Bihar Centre

Chairman's address by Shri A. S. Shrivastava, B.Sc., M.I.E.E., M.I.E., at the 19th Annual General Meeting of the Centre on March 25, 1966

After welcoming Shri Mahesh Prasad Sinha, the Chief Guest, and Minister for Irrigation and Power, Government of Bihar, and other invitees, Shri Srivastava thanked the Committee of the Centre for electing him the Chairman for the ensuing year.

Paying homage to the late Prime Minister Shri Lal Bahadur Shastri, and the late Dr. H. J. Bhabha, the illustrious scientist, Shri Srivastava said, 'I consider it an honour to be associated with the Institution. But this calls for certain obligations. The glory of any corporate body is reflected in the efforts and contribution of its members, and they fail in their duty if they do not help in promoting the aims and objects of the Institution to which they belong.

The Third Five Year Plan is almost coming to a close now. It is true that our national ambitions have not been fulfilled to the extent we would have liked, but I do not think there is any reason for lamentation. A look at our industrial growth as given in the following table, is quite imposing:

Table 1

Growth of production in major industries

Industry	Actual production in the year 1950-51	Production by 1963	Target for 1965-66
Aluminium, hundred tons	3.7	53.3	80.0
Iron and steel, million tons	1.4	5.9	9.2
Iron ore, million tons	3.2	14.8	30.0
Coal, million tons	32.3	61.0	97.0
Machine tool, million Rs.	3.4	180.0	300.0
Nitrogenous fertilizer, thousand tons of nitrogen	9.0	386.0	800.0
Petroleum products, million tons	Nil	7.6	9.9

For industries, we are consuming about 73% of our total generation of electricity. In this period, the per capita generation of electricity has gone up from about 19 to 55 kWh. But we are still a backward nation. The level of electricity sales is an index of a nation's prosperity. In India, the power is generated at the rate of 9,280 kWh. per km.^{2}; whereas Japan generates 43,300, New Zealand 33,800 and Philippines 14,100 kWh. per km.^{2} area. As regards the per capita consumption, India stands far behind. Whereas it is 55 for India, for the world as a whole it is 850 kWh. Sweden's per capita consumption is 5,250; that of the United States 5,300; and of the U.K. 3,040 kWh.

This highlights the task before us—the engineers. I come to the other object of the Institution, *i.e.*, 'to diffuse among the members information on all matters effecting engineering and to encourage, assist and extend knowledge and information connected therewith'. I have already said that membership of the Institution involves obligations as well. The one obligation is to better one's own technical proficiency and to disseminate one's knowledge to others, and acquire knowledge gained by others for himself. An active participation, therefore, in activities of the institutions becomes the obligation of all the members. The Chairman of a Centre of the Institution has a twofold duty. Firstly, to manage the day to day affairs of the Institution, and secondly, to strive for the furtherance of its objectives. In the latter task, I seek your cooperation by actively and dynamically taking part in its activities, and in making it a lively and living organization.

Engineers and engineering profession suffer from a great handicap in this country. Whatever has been achieved—and I will admit quite a lot has been achieved—is in spite of odds and back pulling factors. We are not allowed a novelty of approach, and our bosses lack faith in us. We are bound by outmoded, outdated and crippling audit, and suspicious and obstructing administration, which has no or little knowledge of the problem. General knowledge, however, may be good, but cannot solve engineering and its allied problems.

The entire structure of any engineering organization has to be conceived as a whole, with well defined goals and objectives aimed at, and with well defined ideas as to how the various parts of the system are to be interrelated. For this, the decisions will be more appropriate if they are based on experience, knowledge of the system, and intuition arising from long association. It is, therefore, a statement or a catastrophic fact that engineers are still not being associated with the administration. The need and urgency of this matter has been voiced emphatically in various forums, and has also been acknowledged by all our top ranking leaders. Our President—Shri Kapadia—went to the extent of saying that engineers should refuse to serve under administrators. I appeal to our Minister for Irrigation and Power, and our Minister for P. W. D., to give an effect to the arrangement whereby the engineering undertakings are headed by engineers, and the engineers serve as secretaries to the Government in the engineering departments.

The world is becoming more and more technical everyday. This is an unquestionable fact. The face of technology is changing very fast, and the problem before the profession is to avoid rapid obsolescence of skill. Unfortunately in our country, the engineers are not given a prime position in society, which is their due share. In matters of emoluments, social status or say in determining the shape of projects they occupy a secondary place, primacy being given to 'civil servants'. This will be evident from the difference in the pay-scales of the civil servants and equivalent posts in the engineering services, and the higher pay-scale which the Government has recently sanctioned to the administrative services. I also realise that developments can take place only when law and order prevail. The civil servants have also a place of importance in our society, which one must fully recognize. But today, when I find there is a sense of frustration amongst the engineers, and they feel themselves a victim of routine, that administrative dominance is stifling engineering acumen, I ask myself 'Are we not drifting from the right direction ?' The engineering field has been becoming competitive in an international sense. In spite of the fact that on account of fast mobility, the various nations of the world are coming so nearer that there will exist an inter-dependance in matter of raw materials and experts, if a nation has to stand on its own. Can we then attract the best men and imbibe in them a devotion to the profession, if we do not give them a square deal. I, therefore, submit these problems to our leaders and request them to create conditions in which engineering talent can flourish. I have no complaint about the private sector. It is only the public sector which is suffering from traditions and misdirected perspectives.

Engineers are very often accused of corruption. This is at least a general feeling. I am not here to defend a corrupt engineer, nor to deny his existence. Where so much corruption is prevailing all round, it will be a great wonder if all engineers were honest. It is true that in a society for corrupt men to exist, there must exist men who corrupt, and unfortunately, at present in our society both the categories of men exist in disgustingly large number in every walk of life. I will, however, say to our fellow engineers that they must realize that the welfare of the society lies substantially in their hands, and they can gain their rightful place in the society only by maintaining a high standard of ethical conduct. Ethics is a difficult theme to define. It is a combination of conduct and morality which has an impact on all we come in contact with. I will quote here from the 'Code of Ethics for Corporate Members' which the Institution has introduced for its members:

> 'A Corporate Member should recognize the principles of honesty, justice and courtesy to guide him in the practice of his profession and in his personal conduct. He should not only observe them passively, but should apply them dynamically in the discharge of his duties to the public and the profession.
>
> He should scrupulously guard his professional reputation and avoid association with any enterprise of questionable character. He should uphold the dignity and honour of the Institution."

Delhi Centre

Chairman's address by Maj.-Gen. R. A. Loomba, M.I.E., at the 39th Annual General Meeting of the Centre on February 13, 1966

After welcoming the Minister of Information and Broadcasting—the Chief Guest, and other invitees, Shri Loomba thanked the Committee of the Centre for re-electing him the Chairman for a second term.

Delivering the Chairman's address, Maj.-Gen. Loomba said, 'The Delhi Centre has shown a steady increase in its membership during the last one year, and it is gratifying to note that majority of them are Student members, taking up the profession of engineering. A number of technical lectures were held during the year, but I have to say with some regret that the attendance at these meetings was not very encouraging. We have recently concluded a seminar on 'Statistical Techniques in Modern Management', at which various fields of industry were represented and the discussions were of mutual benefit to those who participated. It is our hope that we would be able to organize similar seminars and discussions during the coming year for the advancement of our profession and the benefit of our members.

Lessons from the war

In my address last year, I had broadly mentioned the role of engineers in a future war, and given some indication of the charter of the technical corps of the Army. A great deal has happened during the past one year; we have successfully countered the aggressive designs of a military dictatorship and have weakened his war machine. The country is truly on a 'war footing' and has never been as united and determined as it is today to make sacrifices and to meet external threat from any quarter. It would be interesting to review briefly the major problems faced and lessons learned by us as engineers during the twenty-two day war.

The reduction of supplies and cutting off of aid from certain countries pose a serious problem, driving home the axiomatic truth that no nation can fight for long to retain its freedom with foreign aid in weapons and equipment. We must be self-sufficient in the defence equipment. To achieve this, would no doubt, take time and require many sacrifices on our part. It has become all the more necessary that we should make the equipment to give useful service for as long a period as possible. This calls for better care in handling and operation and higher standards of maintenance—thus emphasising the need for highly trained and skilled technicians in the Defence Services. There is an acute shortage of skilled technicians and, in spite of the emergency, these deficiencies persist. Closely linked is the urgent need to re-orient our ideas on the repair of equipment, and to bend our energies towads greater improvisation, maximum reclamation of spares and parts, and the use of what may be termed 'in lieu' items.

With the large scale deployment of our forces on the borders, the demands for strategic and tactical roads in border areas have greatly increased, and the urgency for speedy execution has been emphasised repeatedly. It is important that these new roads are completed early, as their presence would help the military commanders to position their strategic reserves correctly, to enable them to switch over and deploy them with speed at the right time and the right place. The strategic roads must initially be built to conform to superior specifications to meet military requirements, and financial consideration must not out-weigh the military necessity. As is well known, dust is a terrible nuisance because it reduces visibility and hampers movement of convoys. It gives away surprise by disclosing the location of formations. Out of sheer necessity therefore the bulk of road movement takes place at night, under extremely trying conditions.

As far as the railways are concerned, it is to their credit that the movement and concentration of military formations was carried out smoothly and with speed. It was indeed a remarkable achievement. All the railway staff rose to the occasion and in spite of air attacks remained at their posts thus contributing vitally to the success of our operations. There is, however, a requirement for devising ways and means of loading and unloading goods and equipment quickly and also for carrying out repairs to damaged bridges and other facilities with maximum speed. These are problems to which, no doubt, the railway engineers are now paying their attention.

The valuable contribution of the Indian Air Force to the land battle has been widely acclaimed, and the nation's gratitude is due to the gallant air men who achieved and maintained this measure of air supremacy. But this would not have been possible if the air-craft had not been kept up in the air as a result of the magnificent efforts of the maintenance and technical services of the Air Force. In the opening stages of any war, it would be the enemy's efforts to knock out our air fields and to keep them out of commission by continuous and sustained air attacks. We, as engineers, have to devise ways and means for quick repair of run-ways and damaged technical facilities, to reduce interruptions to the absolute minimum and to enable the maximum number of air-craft to take to the air. That the Corps of Engineers was able to achieve this is reflected in the success of the air support given to the army.

The role of a reliable and efficient system of intercommunication in the field is generally not fully appreciated. Modern wars require quick means of transmitting orders, and a commander impresses his will and his personality on his subordinates by direct communication. In the 'fog of war' that invariably envelops a battle, these means of contact must be quick and reliable, otherwise chaos and confusion would become inevitable. We need to concentrate on the development and production of telecommunication equipment with greater determination and vigour.

Administrative changes

It is generally acknowledged that advanced techniques with modern outlook have been adopted in industries which is a healthy sign. But in the field of administration we are still lagging by a period of about half a century and are depending on outmoded rules and procedures, quoting past precedents and relying on 'instincts' and 'compromise' for important technical decisions. There are increasing political pressures in these fields, and with bureaucrats at the helm of administration, our actions remain rigid and far removed from the changing and growing needs and aspirations of the people. The theory commonly advanced by him is that there is a shortage of engineers in the country, therefore, they must not be burdened with administration but should concentrate on the technical problems facing the country, which require their urgent and undivided attention. Further, the bureaucrats argue, that being technical men, they tend to see only their point of view and do not appreciate the inter-relationship with social and human problems. Thus he justifies the need of a civil servant to interpret the technical views 'impartially' to the minister and the decision making body.

The result of this pattern is that the technician does not normally have direct access to the policy making head and his views are diluted and modified to suit pressures and precedents. Further, experience shows that the technocrat has to spend most of his time in making the bureaucrat appreciate the technical implications (which, of course, he cannot because of his lack of knowledge and lack of technical training), which he could more profitably use in doing his job. This is the state of affairs which is largely responsible for our present-day ills in administration. We seem to forget that during the days of the British the civil servant 'ruled' and not 'served' the country. He represented the policy making echelon of administration, which today is the function of the parliament and the ministers as the people's representatives. The civil servant cannot fit in as an executive in technical spheres. In fact, there appears to be no place for a man of his background and training in a modern technological society. We can no longer accept the theory that a generalist administrator brought up to collect revenue and enforce criminal law in the districts is better qualified to run a technical department because of his emotional detachment; nor can we accept a system of administration in which the country's highest civil and military professionals have to subject themselves to the infructuous and unnecessary task of educating a secretariat. The country cannot progress unless the professionals are given their due place, and it can ill afford the luxury of a tier of ignorance between the policy making authority and the executive.

It is disheartening to see that rules and regulations, procedures and precedents, applicable to Government departments have been extended to public sector undertakings. The civil servant has transferred the obsolete administrative and accounting systems, to enterprises which need to be progressive, business-like and modern in their outlook and functioning. The result is red tapism, fat files, delay, low return for capital invested, and, of course, shortfall in production.

The Government have decided to set up a high powered commission to go into the administrative structure, and to suggest reforms to speed up and stream-line the administrative machinery. Clearly, therefore, the need has been recognized for not only reinforcing and strengthening the structure, but for revolutionizing it. It is hoped that the commission would not ignore the vital technical limbs of our society and that it would look 'forward' to the requirements of a modern technological society and not hesitate to suggest drastic operations however painful they may appear at first.

Defence production

A greater sense of urgency is now required to inspire the Government's efforts to make the country defence conscious as also self-sufficient in the sphere of defence production. A great deal, no doubt, has been done in enlarging the ordnance factories and other defence production units, and a new department of Defence Supply for the purpose of coordination has been created. It is yet to be seen if this arrangement would prove successful in mobilizing the industrial potential of the country and in accelerating the pace of defence preparedness. There is a need for bringing the private sector in to the field of defence production, not only from the point of view of competition but for making maximum utilization of existing resources. Industry must be defence oriented to enable a quick switch over when required in war.

In the field of research and development also, much closer liaison is required between defence, industry, universities and the Council of Scientific and Industrial Research (C.S.I.R.). A great deal of progress has been made in establishing laboratories both in the C.S.I.R. and the department of research and development in the Defence Ministry; but industrial research which should come in the purview of industry is neglected. The universities have also not played their full part in the promotion of research studies. The Government should encourage the establishment of laboratories in the private sector, and in deserving cases subsidise them to the extent required consistent with the work undertaken by them. Industrial progress is in many ways directly related to the interest displayed and the effort deployed on research and development by a nation.

It would not be out of place to mention that in the United Kingdom, a Ministry for Technology has been created. The main purpose of this Ministry is to assume general responsibility for guiding and stimulating national effort to bring advanced technology and new processes into industry. The Ministry has taken over responsibilities for the Atomic Energy Authority and for the National Research and Development Corporation. Further, it has assumed most of the responsibilities of the former Department of Scientific and Industrial Research which was related to industrial research and development. The Ministry of Technology will also initiate technical and economic studies of selected industries and processes. The studies will be followed by preparation and implementation of specific programmes for technological advance. The last and most important function of the Ministry is to study in collaboration with appropriate departments, the social, economic and educational aspects of technological progress. It is for consideration if such a ministry is not a requirement in this country with more powers, and relatively free from financial strangulation to increase the tempo of technological advancement of the country. The scientist and the technologist must now have an important part in planning and a technological plan cannot be isolated from an economic plan, nor can it be steered to its success by a technically illiterate secretariat.

Modern aids to management

Both in public and private administration, it is becoming more and more a fashion to work by persuasion and agreement, adopting 'compromise' as the best solution. This may be a new trend in a democratic society but the inevitable result is growing complexity of public affairs. It also results in major decisions being taken not based on expert knowledge available or in an objective manner. In the interest of efficiency we must replace these outmoded methods by more scientific methods, both in the field of technical advice and administration.

In the field of industrial management, we have not been giving enough consideration and thought to the subject of operational research. It is possible that we are confusing this subject with other techniques and studies like work study, industrial engineering and management accountancy. Work study, with which we are familiar is in general concerned with routines, particularly manual and clerical routines. As its name implies, it aims at minimization of physical effort.

Operational research is used for organization of planning effort and is an aid to management. It is the application of scientific methods, techniques and tools to problems involving the operations of a system with optimum solutions to the problems. It is the attack of modern science on complex problems arising in the direction and management of men, machines, materials and money in industry, business, administration and defence. The distinctive approach is to develop a scientific model incorporating measurement of factors such as chance and risk, with which to predict and compare the outcomes of alternative decisions, strategies or controls. The purpose is to help management determine its policy and actions scientifically. The most important characteristic of operational research is that it is interdisciplinary which requires a team of experts in different subjects who can share their experience in pursuit of a common aim.'

Summaries of Papers Published in the Journal vol. 46, no. 12, pt. HI 3, August 1966

HINDI SECTION

1. Railways in the U.S.S.R. A. Avetikyan, *Non-member*

The total length of railway track in the U.S.S.R. is 130,000 km., and 200,000 persons are employed to run the railway system efficiently. The railways carry 2,300 crores of passengers per year, 120,000 passengers travel daily on suburban trains. Diesel and electric locomotives pull railway trains on tracks which are 80,000 km. long. Every year 2,000 km. of railway lines carrying very heavy traffic are being electrified. Eight-axled electric locomotives of B.L. 80 K. type develop 8,700 h.p. Running stock is being renovated gradually. Automatic signalling has been installed on 35,000 km. of railway track. The number of manual workers is being gradually reduced, and the number now is only 60 per one hundred km. Speeds are being increased on all passenger trains, and on some sections, the speed is now as much as 160 km. per hr. On most passenger carriages arrangements have been made for modern lighting, electric heating, cold water foundations, and preparation of hot coffee. Thus, the Soviet Railways are one of the most efficient parts of the national economy.

2. **Stabilization of Soil. Dr. J. Jha,** *Associate Member*

It has always been the effort of engineers to make good roads at low cost. Due to increase in automobile industries, demand for roads has greatly increased. It is imperative to utilize local materials, if low cost roads are to be constructed. By stabilization of soil, the road can be made to take up heavy traffic and also can be made water-resistant. There are many methods of stabilization, such as, mechanical stabilization, cement stabilization, stabilization by bituminous material, etc. The use of chemicals and other by-products, such as, gluten, molasses, lime, celulose acetate for stabilization, is separately dealt with in the paper. Nowadays, the natural as well as artificial resins have also stepped into the field of stabilization of soil. Artificial resin not only improves the waterproofing property but also increases the strength.

3. **Interconnection of Electric System and Their Economic Working. B. L. Mathur,** *Non-member*

This paper describes briefly the utility of inter-connection of electric systems into grids. Incremental rate of load distribution in electric stations in the grid system has been discussed in detail.

4. **Glorious Annals of the Ganga Canals. Baleshwar Nath,** *Member*

Ganga Canals, as depicted in this paper, comprise a glorious chapter in the development of western parts of Uttar Pradesh, where irrigation has yielded excellent results. Further irrigational development is sought through construction of a reservoir on the Ram Ganga, a tributary of the Ganga, diverting its stored water to the Ganga, upstream of where Lower Ganga Canal takes off, and where a barrage is replacing the century-old masonry weir. In this paper the author has narrated the circumstances which led to the construction of the Ganga Canal in the last century, and has traced its techno-operational development during the course of its one hundred years of existence. It has been shown how the upper Ganga Canal taking off at Hardwar was operated with indigenously built headworks for over 50 years, and how the difficult terrain in the head reaches of the Ganga Canal, between Hardwar and Roorkee, was negotiated with monumental cross drainage works, one of which is the world famous Solani Aqueduct. Further, it has been shown how the developing irrigational requirements of the Ganga-Yamuna Doab, more particularly, in its lower half had to be met 25 years later with the construction of a Lower Ganga Canal taking off at Narora. Entering the modern age, it has been shown how hydro-electric development took place on the falls provided on the Upper Ganga Canal, how the generated electricity led to growth of deep tubewell irrigation, exerting at the same time prophylactic action on the rise of water table in the irrigated areas. The paper is adequately illustrated with sketches and photographs are presents in short, the developmental picture of the greatest canal system in India, irrigating at present 3.2 million acres of farm lands

5. **Methods of Construction of Tunnels. Tej Narayan,** *Non-member*

This short paper describes briefly the various methods of construction of tunnels including excavation, preparation of timber frames, and methods of drainage and ventilation inside them. Use of theodolite for their correct layout, and disposal of excavated matter has also been explained.

6. **Rigid Runways and their Joints. Vishwambhar Prasad,** *Associate Member*

Civil and Military traffic has greatly developed in India since independence in 1947. Construction of suitable rigid and flexible runways for all kinds of aircraft at the large number of airports in the country has become very important. Rigid pavements on runways require careful arrangement of expansion joints to save them from cracks due to varying temperatures in extremely hot to severe cold weather in this vast country. This paper describes in detail suitable arrangements of all types of expansion joints, their construction, their filling materials, and various precautions necessary to execute this work efficiently.

7. **Sir Lakshmipati Misra—a Life Sketch. Vishwambhar Prasad,** *Associate Member*

Sir L. P. Misra was born on July 4, 1888, in Mainpuri District of Uttar Pradesh. After graduating from Agra in 1907, he joined Thomason Civil Engineering College, Roorkee, and qualified in 1911 for the grade of an Assistant Engineer with a Higher Certificate. He was taken into the service of Indian Railways as an Assistant Engineer on Oudh and Rohilkhand Railway. In 1927, he was selected for being sent to Europe for a study of general organization and administration of English and Continental Railways. On his return in 1928, he was posted to East Indian Railway, and on account of his brilliant achievements rose to be the Chairman of the Railway Board. He retired in 1945. The High honour of Knighthood was bestowed by the British Government on him in 1944. An honorary degree of Doctor of Engineering was awarded to him in 1959 by the University of Roorkee for his distinguished services to the engineering profession. He was the President of the Institution of Engineers (India) in 1942-43. After retirement from Railway Service in 1945, Birla Brothers appointed him General Manager of Hindustan Motors, which he built up from scratch to one of the most successful Indian industries. This paper describes the many brilliant achievements of Sir Lakshmipati in engineering and industrial fields.

Summaries of Papers Published in the Journal, vol. 47, no. 1, pts. CI 1, ME 1 and ET 1, September 1966

CIVIL ENGINEERING DIVISION

624.131.53

1. **Distribution of Stress on Sliding Surface in Cohesionless Soils. F. Basu,** *Associate Member*

In the analysis of stability of slopes and foundations, a choice of assumption about the distribution of the normal stress on the surface of sliding has to be made. In the absence of a theoretical analysis, the assumptions are arbitrary. The problem is such that a direct experimental verification of the stress distribution appears to have a very remote possibility. In this paper the distribution of the normal stress has been obtained theoretically for cylindrical and spiral sliding surfaces by solving Kotter's equation. It is found that the assumptions presently made are incorrect.

532.53.001

2. A Dimensionless Study of the Longitudinal Element and Profile of Hydraulic Jump. N. K. Gupta, *Non-member*

The longitudinal element and profile of a hydraulic jump are important elements in the design of a tilling basin. In this paper, the experimental results of Bakhmeteff-Matzke and Moore have been analyzed. Functional relationships have been suggested for the length and profile of a hydraulic jump in a rectangular channel. The equations are applicable over a wide range of kinetic flow factors and the calculations involved are simple. The paper provides a handy tool for evaluating the length and tracing the profile of a hydraulic jump conveniently.

624.072.2 : 624.012.45 : 624.043

3. Ultimate Load Design of Reinforced Concrete Beams in accordance with the I.S. Code 456-1964. S. K. Mallick, *Non-member,* **and R. K. Narasimhan,** *Associate Member*

The ultimate load method has lately been incorporated in the Codes of several countries for the design of members in flexure and under axial or eccentric thrust. In this paper, a comparison of the recommendations of I.S. : 456-1964 with corresponding provisions of the British Standard and the American Concrete Institute is presented.

624.15

4. Numerical Solutions to Some Consolidation Problems by Relaxation Method. S. Panchanthan, *Member,* **and S. Boominathan,** *Non-member*

Most of the present-day estimates of the settlement of loaded structures are based on oversimplified assumptions such as (i) the flow of pore water is one-dimensional, (ii) there exists a linear relationship between effective stress and void ratio, and (iii) the modulus of elasticity of the consolidating medium is constant throughout the layer. Whenever these assumptions are to be taken into account, analytical solutions of consolidation problems become very much complicated and in this report, a numerical method, using relaxation techniques which can take into account the above assumptions, has been used to solve a number of consolidation problems. The numerical solutions so obtained is compared with the analytical solutions and the results indicate the fairly satisfactory agreements between the two solutions.

624.132 : 624.155

5. Predicting Displacements of Laterally Loaded Piles in Non-cohesive Soils. S. Prakash, *Associate Member,* **and S. L. Agarwal,** *Non-member*

In the design of laterally loaded piles in non-cohesive soils, allowable deflections limit the load to which the pile can be subjected. Determination of load-deflection characteristics of a pile in advance of construction is, therefore, of importance to the foundation engineer. The problem of laterally loaded pile involves the concept of soil-pile interaction and the deflection of the pile under lateral load can be predicted in a number of ways, *i.e.*, by performing a test (i) on a pile of relatively short length (rigid pile), (ii) on a long pile (flexible pile), or, (iii) by actual measurement of the modulus of horizontal subgrade reaction. In this paper, the relative merits of each method have been discussed. The data from tests on model aluminium piles with different depths of embedment in sand has also been presented. An analysis of data indicates that the test data from rigid piles, when used to predict the displacements of a flexible pile, may yield erroneous results.

532.52 : 681.121.001

6. Drag Characteristics of Pressure Differential Metering Devices. M. V. Ramamoorthy, *Non-member*, **and K. Seetharamaiah**, *Member*

This paper presents the drag characteristics of pressure differential metering devices and their correlation to the discharge coefficients of various such meters. This theory can be used to predict the performance of any type of metering devices which have not yet been used as discharge measuring devices, provided the drag coefficients of their elementary forms are known.

624.012.45 : 536.5.001

7. Temperature Effects in R. C. Frames, Y. L. Sadana, *Associate Member*, **and K. C. Verma**, *Associate Member*

This paper presents a method for the analysis of R.C.C. frames considering uniform temperature change in the beams comprising a frame. The temperature effect on columns, being negligibly small, is not considered. The other possible states of temperature affecting the frames have been discussed. The theoretical aspect of evaluation of initial end-moments in case of steady state temperature of a beam or beams of the frame, which is sometimes likely to occur, has been indicated. The solved example also shows the method of finding out stiffness factors, carryover factors and initial end-moments for members with two unequal sections. The method indicated is equally applicable for any other loading on the frame.

624.012.45 : 624.073 : 531.23

8. An Approximate Method of Moment Distribution in Two-Way Reinforced Concrete Rectangular Slabs. Dr. N. C. Sinha, *Associate Member*, **and K. P. Banerjee**, *Non-member*

This paper deals with a distribution procedure for the computations of moments in rectangular elastic plates supported on all four sides and continuous on any or all directions. The method gives good result for slabs having a side ratio close to unity. Only loads uniformly distributed can be considered, but all panels need not be loaded. The method, in general, is similar to the Hardy Cross method of moment distribution with the constants calculated on the basis of the analysis enumerated.

624.131.52

9. Bearing Capacity Factors for Shallow Rough Strip. Dr. A Siva Reddy, *Associate Member,* **and S. R. Bhargava,** *Non-member*

For a large number of log spiral failure, surfaces loads causing failure have been analytically calculated for soils with constant values of cohesion and angle of internal friction. From the lowest load causing failure, the dimensionless bearing capacity factors N_{cA}, N_{qA} and $N_{\gamma A}$ analogue to the Terzaghi's bearing capacity factors N_c, N_q and N_γ are computed and the two sets of factors compared. On the same lines, the bearing capacity factors are also calculated for soils whose cohesion either increases or decreases linearly with depth and graphs for these are given.

624.155 : 624.042

10. Resistance of Piles to Lateral Loads. G. Subramanyam, *Non-member*

This paper deals with the basic problem of the laterally loaded piles and its solution. The various factors coming into picture in this problem are thoroughly discussed. The solutions of basic differential equation for the laterally loaded piles are presented for different types of soils. The results of the tests conducted on model aluminium piles are also presented and the change in the behaviour of short piles and long piles discussed. The procedure for drawing the deflected shape of the laterally loaded pile is also discussed.

532.53.001

11. Studies on the Effect of Retrogression in the Tail Water Levels on the Stability of the Hydraulic Jump in the Stilling Basin of Bhakra Dam Spillway. Dr. H. L. Uppal, *Member,* **T. D. Gulati,** *Non-member,* **and B. D. Sharma,** *Non-member*

The design of the Bhakra dam spillway stilling basin was finalized for a maximum outflow of 290,000 cusec. with the corresponding tail water level of EL. 1206. This provided a maximum depth of 111 ft. in the stilling basin for the hydraulic jump to form. Studies carried on a number of models in the Land Reclamation Irrigation and Power Research Institute, Amritsar, and at the Hydraulic Research Station, Malakpur, to verify this phenomenon and devise suitable measures to prevent the sweep out of the hydraulic jump, are given in the paper.

ROADS AND ROAD TRANSPORTATION GROUP

625.71.001

12. Study on Life Characteristics of Roads. G. C. Sharma, Member

This paper describes the life characteristis of roads in Assam for earth, gravelled, metalled, bitumen grouted and black topped surfaces constructed, retired and remained in service for nearly half-a-century. An assessment has been made separately for the various elements of highways, *e.g.,* right-of-way and road embankment, roadways pavements, waterway structures and other miscellaneous appurtenances within the limitation of statistical data available

MECHANICAL ENGINEERING DIVISION

621.791.053 : 624.043.001

1. Determination of Residual Stresses due to Welding. M. Bhattacharyya, *Non-member,* **K. N. Kundu,** *Associate Member,* **Dr. R. K. Chakrabarti,** *Member,* **and Prof. G. C. Sen,** *Member*

This paper derives the residual stresses generated in butt-welded plates of the same thickness using various currents, the welding being done from one end to the other, with the help of electric resistance strain gauge method. An attempt has also been made to find out the possible relationship of the residual stress generation with the rate of heat input during welding.

621.791.052 : 624.023 : 534.01

2. Effect of Welded or Bolted Joints in a Portal Frame on the Natural Frequency of Damped Vibration. B P. Chatterjee, *Non-member,* **and Dr. R. K. Chakrabarti,** *Member*

The conditions of corner joints of a simple portal frame, such as perfectly hinged, semi-rigid or rigid, may greatly affect the natural frequency of oscillation of the frame. This paper presents the investigation to determine the natural frequency of vibration of frames with different types of joints under loaded and no-load conditions. It also studies the decay curves and finds that for the frames with semi-rigid corner joints, the logarithmic decrement is higher than that for frames with rigid joints in the loaded condition.

621.874

3. Overhead Travelling Crane Tracks. G. V. Joshi, *Non-member*

This paper describes the measurements of span and alignment of overhead crane tracks, so as to satisfy the norms prescribed for the heavy duty crane having a wide span

621-75 : 620.178.3

4. Strainageing under Fatigue Conditions. Dr. J. C. Levy, *Non-member* **and S. L. Kanitkar,** *Associate Member*

Strainageing is a diffusion phenomenon and the rate of strainageing depends upon the activation energy. Under conditions of stress the rate of strainageing increased and the value of the activation energy is effectively modified. Values obtained for activation energy under fatigue conditions and those under simple stress conditions are in disagreement and the dependence of diffusion rate on stress cannot explain this discrepancy. The reversed speed effect observed by Forrest is considered and it is suggested that diffusion similar to grain boundary diffusion may be responsible and the slip hands in fatigue may be playing a role similar to grain boundaries

621.867.2

5. Belt Conveyor Design for Bulk Handling. R. G. Lynn, *Non-member*

Belt conveyor arrangements, properly designed, provide efficient, completely indigenous means of handling bulk materials. This paper indicates a design procedure which is proven, and which has been successfully applied to the design of well over seventy belt conveyor arrangements in the TELCO organization.

621.436 : 621.438

6. Diesel Engine in Association with Gas Turbine, A. S. Loiwall, *Non-member,* **D. M. Dhinra,** *Non-member,* **and R. C. Patel,** *Member*

The future development of Diesel engine will inevitably depend on its association with a gas turbine. This paper explores three known methods by which such an association may be achieved, *viz.*, turbocharging, compounding and the use of a gasifier. The performance obtainable from these three arrangements for both 2-stroke and 4-stroke cycle engines, with and without charge cooler, considering various compression ratios, adiabatic efficiencies and trapped air-fuel ratios are derived and it is shown that high specific output is obtained at high manifold pressures without exceeding the established limitations for maximum cylinder pressure, maximum piston temperature and turbine inlet temperature. The characteristics in the possible ranges are compared and it is concluded that a highly supercharged 2-cycle engine, used as a gas generator and feeding a power turbine, would provide an efficient and versatile power unit.

531.43

7. Mechanism of Friction. Prof. R. D. Singh, *Associate Member,* **and A. K. Jha,** *Non-member*

This paper reviews the existing theories of friction between metallic bodies in contact with each other and concludes that considerable research work will have to be carried out to understand fully the mechanism of friction in case of metals and non-metals.

ELECTRONICS AND TELECOMMUNICATION ENGINEERING DIVISION

621.373.52.001

1. Single Transistor Voltage Controlled Oscillator and Its Application. K. Gangadharan Nadar, *Associate Member*

This paper discusses the theory and performance considerations pertinent to a single-transistor voltage-controlled oscillator. The performance characteristics of such a circuit and also its application is dealt with in detail. The wide range of design flexibility and usefulness are demonstrated by a block of device fabrication. A comparison is made with conventional circuits and also their shortcomings are pointed out.

621.3.032.36 : 621.397

2. Fluctuation Theory of Luminance Discrimination for the Light-Adapted Eye and Its Particular Application to the TV Case. P. S. Moharir, *Non-member*

The fluctuation theory of luminance discrimination was developed for the dark-adapted eye by Bouman, Vos and Walraven. It has been extended in this paper to the case of light-adapted eye. It has also been shown that the required data for the light-adapted eye can be calculated using the data for the dark-adapted eye if one knows the adaptation level. It is further shown that if the human eye is considered as a sufficiently fast device then the solution for the television can be obtained very easily.

621.397.001

3. About the Gray Scale Properties of the Eye. P. S. Moharir, *Non-member*, and K. V. Saprykin, *Non-member*.

In view of estimating the upper limit on the number of shades of gray that a television system should reproduce, the number of shades of gray that the dark-adapted eye can resolve over about a contrast range of 1.5×10^7 has been calculated. The maximum number of shades of gray that the eye can distinguish apart is also studied as a function of restricted contrast range and the empirical relationship has been fitted to the data. Some calculations over a narrow contrast range have been done for the light-adapted eye.

AUTOMATIC CONTROL GROUP

621-52.001

4. A Technique of Characterization and Equivalent Model Construction of a Class of Nonlinear Systems. D. N. Khandelwal, *Non-member*

The rapid increase in the complexity of modern technology, whether industrial, military applications or space research programmes, has placed severe strains on the control systems which invariably form the central core. The need for an insight into the controlled processes in all possible parametric changes during operation and subsequent adaptation has led to the use and development of self-adaptive control systems. The crucial problem in nonlinear as well as linear control system is the identification of process characteristics. The solution to the problem of identification of nonlinear systems belonging to the class η_h of Zadeh by constructing an equivalent model has been presented in this paper. The models of the zero-memory systems and of the systems with memory have been constructed. The modified Hermite polynomials have been used to represent the orthonormal polynomials, $\phi_n(x)$. In each path of the multipath model, the Hermite function generators are followed by realizable linear networks containing adjustable parameters. This investigation considered a class of nonlinear systems belonging to Zadeh's class η_h. However, a large number of nonlinear processes fall in this category and the present study, therefore, is not unduly restricted.

INSTITUTION NOTICES

Submission of Papers for the *Journal* in the metric system of units

At the sixth meeting of the various Division Boards held in Bombay on August 7, 1966, it has been decided that, in keeping with the stipulations of the Weights and Measures Act, 1956, which allowed a period of changeover of ten years, henceforward the papers submitted for publication in the *Journal/Bulletin* should be written in the metric system of units. Any paper written in the older system of units, if received, will be returned to the author for necessary modifications.

Draft Indian Standards

The following draft Indian Standards have been issued recently.

1. Draft Indian Standard Code of Practice for Reed Walling—Doc : BDC (1076).

This Standard covers the use of reeds and reed-boards in the construction of walls and roofs in buildings.

Members may send their comments on this draft Standard before December 20, 1966, to Shri T. R. Mehandra (*M*), 14 Asaf Ali Road, Ajmeri Gate Extension, New Delhi, who is the Institution representative on the Sectional Committee dealing with this Standard.

2. Draft Indian Standard Specifications for Cold Rolled Carbon Steel Strips for Ball and Roller Bearing Cages—Doc: SMDC 19 (733).

This Standard covers the requirements for deep drawing quality cold rolled carbon steel strips suitable for manufacture of cages for ball and roller bearings.

3. Draft Indian Standard Specifications for Carbon-Chromium Steel for the Manufacture of Balls, Rollers and Bearing Races—Doc : SMDC 19 (742).

This Standard covers the requirements for three types of high carbon-chronium steel is the form of billets bars, tubes, rings and wires to be used in the manufacture of ball and roller bearings for general purposes.

Members may send their comments on these draft Standards before December 31, 1966, to Dr. G. P. Chatterjee, (*M*), Research and Scientific Adviser, Research and Control Laboratory, Durgapur Steel Plant, P.O. Durgapur 3, West Bengal, who is the Institution representative on the Sectional Committee dealing with these Standards.

INSTITUTION NEWS

The President's Itinerary

On July 29, 1966, Shri B. P. Kapadia, President, came to Calcutta to attend a meeting of the Examinations Committee. He left for Bombay on July 31, 1966, to attend meetings of the Council, Finance Committee, etc., held there during August 5-7, 1966. Thereafter, the President flew to Bangalore on August 9, to meet the Chairman and members of the Mysore Centre, and to address a meeting of the Students' Chapter there. From Bangalore he proceeded to Mysore the very next day, to meet the Chairman and the members of the Mysore City Sub-Centre, and to address the Students' Chapter there. He returned to Bangalore the same evening, and stayed there till he left for Dharwar *via* Belgaum and Hubli on August 13, 1966. At Dharwar, on August 14, the President attended

the inauguration ceremony of the Dharwar Sub-Centre, and met the Chairman and other members of the Sub-Centre there. He returned to Bangalore again on August 15, to fly for Hyderabad. On August 16, he flew to Delhi from Hyderabad, and proceeded to Roorkee on August 17 to meet the Chairman and the members of the Roorkee Sub-Centre, and also to address the Students' Chapter there. He also met the Vice-Chancellor, Roorkee University, and visited the College of Engineering, Roorkee, the Earthquake Engineering School, the Central Building Research Institute. On August 18, he returned to Delhi only to proceed to Kanpur on August 19, to investigate by meeting the local engineers the possibility of forming a Sub-Centre there. He stayed in Kanpur till August 20, and left for Lucknow the next day. On August 22, the President met the Chairman and the members of the Committee of the Uttar Pradesh Centre, and addressed the Students' Chapter at Lucknow. He also visited the Railway Research Institute at Lucknow. On August 23, he attended the meeting of the Selection Committee of the Vice-Chancellor, Lucknow University. He left Lucknow for Allahabad on August 24, to meet the Chairman and members of the Committee of the Allahabad Sub-Centre, and to address the Students' Chapter there. On August 26, the President left Allahabad to arrive in Bombay at night.

International Association for Shell Structures Congress, Leningrad, September 6-9, 1966

An international Congress of the International Association for Shell Structures (LASS) was held at the Tauride Palace in Leningrad from September 6-9, 1966. Arranged by the State Building Committee of the U.S.S.R. (Gosstroy) under the auspices of the IASS, the themes of the Congress were (i) Design of Shell Roofs—(a) Structural Design, (b) Typology, and (c) Calculation; (ii) Role of Research in the Design of Shells; (iii) Manufacturin and Erection of R. C. Shells ; (iv) Manufacturing and Erection of Shells made of Metal, Wood, Plastics and other Materials; and (v) Examples of Erection of Structures.

Seventy-five papers from 28 countries were presented. Shri S. P. Banerjee (*M.*), Consulting Engineer, Calcutta, presented a paper under theme (i) and took the Chair of the session discussing the theme (vi) The Congress sessions were followed by technical visits to Kiev, Tbilisi and Moscow. On his way to Leningrad, Shri Banerjee also attended a Conference on Space Structures in Vienna on September 4, 1966.

International Microwave Power Institute

The organization of a new international technical society for the exchange of information on the applications of microwave power for industrial processes has been announced by a group of Canadian and U.S. scientists. The new group, known as the International Microwave Power Institute (IMPI), was incorporated in Canada in July 1966, following a successful symposium on the subject of industrial applications of microwave energy held at the University of Alberta, Edmonton, Alberta, Canada. The industrial applications of radio-frequency energy in microwave spectra (generally 915 MHz or 2,450 MHz) are among the most important fundamental technologies to have been developed in recent years. Microwave energy presently serves such diverse fields as food preparation; the cooking of chicken; potato chip heating and drying; bakery products preparation; removal of solvents from drugs; wood gluing, drying, and curing; and the accelerated polymerization of epoxy resins. The International Microwave Power Institute plans its next annual symposium at Stanford University, Palo Alto, California, from March 29-31, 1967.

Information regarding membership can be obtained from the International Microwave Power Institute, 1744 West Broadway, Vancouver, British Columbia, Canada.

NEWS OF MEMBERS OF THE INSTITUTION

Shri R. N. Joshi, B.E., M.I.E., Chairman of the Bombay Centre and also a Member of the Council of the Institution for many years, has been elected Dean of Faculty of Technology in the University of Bombay.

Shri D. R. Bhise, M.I.E., Hydraulic Engineer, Bombay Municipal Corporation, received wide appreciation for his services during the recent unprecedented water crisis in Bombay. In a letter of appreciation Shri P. B. Gajendragadkar, Vice-Chancellor, Bombay University, and former Chief Justice of India says, 'His statements which were always based on available data, were clear, lucid, unambiguous and precise; besides, they showed an unmistakable sense of optimism and self-confidence. I must say that Mr. Bhise has managed this problem in a very reasonable and efficient manner and the well-planned scheme of reducing the water supply and regulating the same which he has gradually introduced has served its purpose without unduly inconveniencing the public. I am quite sure all the citizens of Bombay must have appreciated the wise and courageous attitude displayed by Mr. Bhise when we faced a very difficult situation'.

FORTHCOMING EVENTS

Symposium on 'Pore Pressures and Shearing Resistance of Soils', Bangalore, September 1967

A Symposium on 'Pore Pressures and Shearing Resistance of Soils' will be held at Bangalore in September 1967. The object of the Symposium is to assemble, summarize and discuss the present state of knowledge on those aspects of strength of soils that are relevant to the analysis of stability of slopes (natural or artificial, cutting or embankment) and their formations. The Symposium will be of topical interest to engineers engaged in the design and construction of earth dams, dykes, breakwaters, or excavation of canals, highways and railways. It is further hoped that this will enable a critical review of the current practices in the design of slopes and embankments bringing out their limitations as well as the uncertainties involved.

Contribution on any aspect of the topics given below or any other allied subject will be accepted for the Symposium.

(i) Basic principles—theories and soil testing

(ii) Selection of the type of test, test procedure and equipment for laboratory as well as field tests

(iii) Application to stability analysis in relation to various critical conditions including problems involving earthquake, creep, progressive failure, and cracking of embankments.

(iv) Studies in relation to special types of soils such as residual soils, expansive clays, fissured clays, highly plastic clays, aeolian deposits, shales and partly cemented soils.

Authors desirous of contributing papers should send the titles and summaries of their contributions by the end of September 1966 and three copies of the full text in published form by the end of January 1967.

Further details can be obtained from Shri R. Datye, Superintending Engineer, Deccan Irrigation Construction Circle I, Government of Maharashtra, Nasik, or, Prof. B. V. Ranganatham, Civil and Hydraulic Engineering Department, Indian Institute of Science, Bangalore 12.

Air Traffic Control Systems Engineering and Design Conference, London, March 13-17, 1967

The Institution of Electrical Engineers will hold a Conference on 'Air Traffic Control Systems Engineering and Design' in London from March 13-17, 1967. Sponsored by the professional group on Radio Navigation and Radio Location of the IEE Electronics Division and the Radar and Navigational Aids Group of the Institution of Electronic and Radio Engineers, the Conference will cover: (i) Information Services, *viz.*, Communications for air traffic control, Navigational aids for air traffic control, Primary radar systems and equipment, and Secondary radar systems and equipment; and (ii) Data Handling and Displays, *viz.*, Display for air traffic control, Methods of character production and presentation, Tracking systems and automatic tracking, Transmission and storage of radar information, and The role of the computer in air traffic control. The Organising Committee invite the submission of contributions for consideration for inclusion in the conference programme.

Further details will be available from the Joint Conference Secretariat, The Institution of Electrical Engineers, Savoy Place, London, W.C.2.

International Symposium on 'Modern Optics', New York City, March 22-24, 1967

An international Symposium on 'Modern Optics' will be held in New York City from March 22-24, 1967. Seventeenth in the series of annual international symposia organized by the Polytechnic Institute of Brooklyn, this Symposium will coincide with the 1967 International Convention of the Institute of Electrical and Electronic Engineers, U.S.A.

This Symposium wil propose to map out the domain of this new science. The laser has brought a host of investigations in nonlinear optical properties of materials within the range of experiment. Emphasis should fall in areas such as holography, spatial filtering, information processing, and electrodynamic measurements in which several novel aspects, physical and theoretical, converge. In the tradition of past symposia, this meeting will provide a review of the present status of modern optics as well as a forum for discussion of the latest advances of interest to engineers and physicists.

Among the more prominent features to be explored in consecutive sessions during the symposium are : (i) Electrodynamics—Coherence, Diffraction ; (ii) Information Processing—Spatial filtering, Communications ; (iii) Nonlinear Effects—Modulation and Detection, Optical Propertes of Materials ; (iv) Optical Instruments—Lasers, Photographic Techniques, Acoustic and other Gratings, Zone-Plate Optics, Lens Applications, Moire Effects ; and (v) Holography—Single Colour, Chromatic.

Further details can be obtained from The Secretary, Symposium Committee, Polytechnic Institute of Brooklyn, 333 Jay Street, Brooklyn, New York 11201, U.S.A.

International Conference on 'Water for Peace', Washington, May 23-31, 1967

An International Conference on 'Water for Peace' will be held in Washington from May 23-31, 1967. The Conference will be a forum for the discussion of the water problems of all people and all nations. The agenda includes discussions on ministerial and expert levels and has been broadly divided as follows :

Ministerial Level

1. Planning and Economics Rural, Urban and Industrial Water Supply
2. Basic Data Needed for the Planning and Management of Water
3. Technology : Present Capabilities and Future Prospects
4. Education and Training
5. Organizations, Institutions, and Finance

Export Level

6. Technology and Research Needs in Water Programmes
7. Basic Data for Water Programme
8. Organizing for Water Programmes
9. Education and Training in Water Programmes
10. Planning and Developing Water Programmes
11. Economics and Finance of Water Programmes

Further information can be obtained from the office of the Secretary General, Mr. R. C. Hagar, Room 1316, Department of State, Washington, D.C., 20520, U.S.A.

Symposium on 'Research in Weather-Tight Joints for Walls', Oslo, Autumn 1967

A Symposium on 'Research in Weather-Tight Joints for Walls' will be held in Oslo, Norway, in the autumn of 1967. To be organized by the Norwegian Building Research Institute on behalf of the International Council for Building Research, Studies and Documentation (CIB), the meeting will discuss problems concerning the design and development of completely weather proof joints and jointing materials for walls. The symposium will also consider mechanism of rain penetration and aerodynamics as these effect the design and behaviour of joints and jointing materials, the effect of movement in building and necessary tolerances. Practical experiences in jointing and in the use of jointing materials, as well as in related research, testing and development will also be presented, and those interested in doing so are invited to make proposals to the symposium organisers.

Further details can be obtained from The Director, Norwegian Building Research Institute, Post Box 322, OSLO Blindern, Norway, or, The General Secretariat of CIB, Weena 700, P.O. Box 299, Rotterdam, The Netherlands.

Second IFAC Symposium on 'Automatic Control in Space', Vienna, September 4-8, 1967

The second IFAC Symposium on 'Automatic Control in Space' will be held in Vienna, Austria, from September 4-8, 1967. This Symposium is being organized by the IFAC Committee on Space on the invitation of the Austrian Committee on Automation.

In pursuance of the aims of the first symposium at Stavanger (Norway) the following topics for original papers are proposed:

Space

Booster control. Guidance. Attitude control. Control with man in the loop. Propulsion system control. Navigation. Nionics applications, including navigation. Optimal trajectory determination, both orbital and interplanetory. Control of landing, on both solid surfaces and water. Automatic exploration systems. Medical monitoring and control. Digital computers applied to control problems.

Underwater

Control of movement of undersea vehicles: submersion, cruising, and on the bottom. Control of hydraulic resistance (Including bionics, e.g., movement of fish). Navigation. Propulsion control (including (bionics). Propulsion. control, including nuclear. Medical monitoring and control.

Underground

Control during peneration. Remote investigation of underground phenomena, including telemetering.

Emphasis will be laid on application to actual space problems and technical realization. Review papers on Automatic Control in specific systems and for tutorial sessions are also expected.

Authors willing to offer papers to one or more of the above mentioned topics should send abstracts to Vienna observing the following items: (i) The abstracts should be submitted in 5 copies not later than October 15, 1956; (ii) The abstracts should not cover more than three pages (500—1,000 words) of typewritten text and should contain: Complete title of the paper with reference to the above mentioned topics, a short formulation of the problems treated, methods for solution and results, and full name of the author, titles and position, private and/or professional addresses; and

(iii) All abstracts should be written in English or Russian (for Russian abstracts English translations are required).

Further details can be obtained from Austrian Productivity Centre, Committee on Automation, POB 131, A-1014 Vienna, Austria.

Symposium on 'Computer Control of Natural Resources and Public Utilities', Haifa, September 7-14, 1967

The Israel Committee for Automation of the International Federation of Automatic Control (IFAC) will hold a Symposium on 'Computer Control of Natural Resources and Public Utilities' in Haifa from September 7-14, 1967. The scientific programme includes discussion on (i) Control of water supply and water salinity; (ii) Control of gas and gasoline supply; (iii) Control of refineries; (iv) Traffic light control; (v) Problems associated with the control of natural resources and public utilities. Those wishing to submit papers should send abstracts of their contribution before December 1, 1966, to the Israel Committee, and the full texts by March, 1967.

Further details can be obtained from Israel Committee for Automatic Control, Faculty of Electrical Engineering, Technion City, Haifa, Israel.

Eighth Congress of the International Association for Bridge and Structural Engineering, New York, September 9-14, 1968

The next Congress of the International Association for Bridge and Structural Engineering (IABSE) will be held in New York from September 9 to 14, 1968. The themes of the Congress are given below:

1. *Safety*

   (i) Critical appraisal of safety criteria and their basic concepts; (ii) Combination of the theories of elasticity, plasticity and viscosity in studying the safety of structure; and (iii) Optimization of structures.

2. *Thin-Walled Structures*

   (i) Theoretical solutions and test-results; (ii) Light-gages cold formed structures; and (iii) Thin-walled deep plate girders.

3. *Tall Multistorey Buildings*

   (i) Plastic design; (ii) Column-free box-type framing with and without cone; and (iii) Dynamic effects of wind and earthquake.

4. *New Practices in Concrete Structures*

   (i) New trends in design and construction of long span bridges and viaducts (skew, flat slabs, torsion box); and (ii) Partially prestressed members.

5. *New Practices in Concrete Buildings*

   (i) Special Problems of tall buildings (spear walls, stability of columns, effect of thermal gradients, construction problems); (ii) Structural lightweight aggregate concrete (concrete technoligy, structural design); and (iii) Dynamic behaviour of reinforced and prestressed concrete buildings under horizontal forces and the design of joints (including wind, earthquake, blast effects).

6. *Dynamic Stresses*

Effect of dynamic stresses (in particular earthquakes, explosives blast, wind) on structures.

Those who wish to present a contribution to the prepared discussion should submit to the General Secretariat of IABSE the title and the summary in quintuplicate by January 31, 1968.

Further information can be obtained from the Secretariat of IABSE, Swiss Federal Institute of Technology, 8006 Zurich, Switzerland.

International Symposium on 'Automation of Population Register Systems', Jerusalem, September 25-28, 1967

An International Symposium on 'Automation of Population Register Systems', organized by the Information Processing Association of Israel (IPA) under the sponsorship of the International Computation Centre (ICC) and the International Federation for Information Processing (IFIP), will be held in Jerusalem, Israel, from September 25-28, 1967.

The subject of the Symposium is one which has keenly interested administrators and automatic data processing experts in many countries for a long time. The problems connected with the automation of population register systems and the planning and operation of such systems cover a wide field and range over such subjects as national and municipal civil registration and elections, health, education, welfare, defence and taxation.

Further details can be obtained from International Symposium on Automation of Population Register Systems, Information Processing Association of Israel, P.O. Box 3009, Jerusalem, Israel.

International Construction Exhibition, Thessaloniki, March 30-April 7, 1968

An international Building and Construction Exhibition will be held in Thessaloniki, Greece, from March 30 to April 7, 1968. Jointly sponsored and organized by the International Fair of Thessaloniki and the International Building Exhibition of London, the exhibition will be held at two-year intervals thereafter. A series of technical conferences will also be held at the same time on subject of special interest and appropriate to building industry.

Further details can be obtained from either of the joint organisers: (1) The International Fair of Thessaloniki, Thessaloniki, Greece ; (2) The International Building Exhibition, 11 Manchester Square, London, W. 1.

BOOK ACKNOWLEDGMENTS

1. **General Metallurgy.** N. Sevryukov, B. Kuzmin and Y. Chelishchev (Translated by B. Kuznetsov). *Peace Publishers*, Moscow, 545 pages.

This book deals with the fundamentals of metallurgy; preparation of ores; metallurgy of iron, ferrous and non-ferrous metals, light-weight metals, and refractory metals.

2. **Railway Construction.** N. Shadrin, *et al* (Translated by G. Leib). *Peace Publishers,* Moscow, 333 pages.

This text-book, with numerous illustrations, is devoted to the fundamentals underlying planning, construction and organization of railway tracks. It also deals with the electrification of railways, problems encountered when constructing railways in adverse geological and climatic conditions, matters relating to rate-fixing, etc.

3. **Fits, Tolerances and Engineering Measurement.** Y. Tarasevich and E. Yavoish. *Peace Publishers,* Moscow, 160 pages.

This book illustrates the fundamental principles concerning the accuracy of mating surfaces as well as the means and methods employed in making the measurements. It also provides the design and kinematics of various instruments used in engineering inspection and measurement.

4. **A Short Handbook of Heat-Treatment.** I. Kamenichny (Translated by I. Savin). *Peace Publishers,* Moscow, 276 pages.

The book describes the heat-treatment charts, heat-treatment procedures for tools, parts of lathes, automobiles, and agricultural machinery. The subjects of quality control of metals before and after the heat treatment, heat-treatment and case hardening of steel, heat-treatment of cast iron, non-ferrous metals and alloys have also been briefly dealt with.

5. **Farm Machinery.** N. Bushuyev, G. Alexeyev, and V. Plaksin (Translated by A. Baikov and V. Kulikov). *Peace Publishers,* Moscow, 303 pages.

This book outlines the design features and purpose of different agricultural machinery made in the Soviet Union, their capacity, setting and adjustment, etc.

6. **Thinking Machines.** L. Gutenmachar (Translated by A Zdornykh). *Foreign Languages Publishing House,* Moscow, 186 pages.

This book discusses many information machines of large-capacity memory with the basic principles of their operation and their use in various fields of science and technology.

7. **Industrial Radiology.** S. Rumyantsev (Translated by S. Semyonov). *Foreign Languages Pubishing House,* Moscow, 276 pages.

This volume, mainly devoted to the use of radioactive isotopes in flaw detection, describes the physical and engineering fundamentals of radioactive isotopes, methods of industrial radiology based on the use of radioactive radiation, labour protection in gammor-radiography, and the effect of defects on mechanical properties of articles and welds.

8. **Quantitative Analysis.** V. Alexeyev. *Foreign Languages Publishing House,* Moscow, 491 pages.

This book sets forth the theoretical principles and practical methods of quantitative analysis of inorganic substances. It includes the description of apparatus, instruments, calculation of results of analysis, application of the methods of mathematical statics.

9. **Collection of Problems in Theoretical Mechanics.** I. V. Meshchersky (Translated by N. M. Sinelnikova). *The Higher School Publishing House, Moscow*, 302 pages.

This abridged translation of 28th Russian edition of the book deals with the problems on basic concepts of statics of rigid bodies and principles of stability of motions. These problems, of practical value have been selected from such fields as the operation of machinery and mechanisms, hydrodynamics, resistance of materials and other branches of science and engineering.

10. **Examples in Mechanical Science for Technicians.** D. R. L. Smith. *Blackie and Sons Ltd.*, 10s, 1966, 100 pages.

This book gives solved and unsolved problems concerning mechanical portion of elementary engineering science.

11. **Fundamentals of Electrical Engineering.** B. L. Theraja. *S. Chand & Co.*, New Delhi, Rs. 16, 2nd edition, 1965, 786 pages.

This book in rationalized metric units, explains the principles of electrical engineering and their applications with the help of numerous illustrative examples.

12. **Engineering Mechanics.** B. N. Thadani. *Asia Publishing House*, Rs. 32, 1966, 665 pages.

This book is devoted to the study of statics, kinematics, plane motion of rigid bodies, and strength of materials, as applicable to engineering problems.

13. **Elements of Mechanical Engineering.** K. P. Roy, S. K. Hajra Choudhury and Dr. S. C. Bhattacharya. *Asia Publishing House*, Rs. 10.50, 2nd edition, 1965, 367 pages.

This revised and enlarged edition of the book discusses the fundamental principles of mechanical engineering as applied to prime movers, materials, and processs.

14. **Electrical Engineering.** S. P. Kukde. *Modern Publishing House, Delhi*, Rs. 25, 671 pages.

This volume of the book in metric system of units is writen with a view to present the fundamental principles of electrical engineering to the students. A large number of solved examples have been included.

15. **A Collection of Standard Questions.** S. P. Kukde. *Modern Publishing House*, 192 pages.

This volume gives solutions of selected questions and problems on the subject of electrical engineering.

16. **Engineering Tables—Part 1.** Compiled by R. L. Bali. *Print Craft*, Jaipur, Rs. 2, 30 pages.

This booklet gives various engineering tables in metric units.

PUBLICATIONS RECEIVED

A copy of the first issue of *Computer Centre Bulletin* has been received from the Computer Centre of the Structural Engineering Research Centre, Roorkee. This Bulletin—planned primarily for designers and research workers engaged in the analyses of a wide variety of structural systems such as prestressed concrete beams, plates, shells, folded plates, complex virendeel girders, multistoreyed structures and space frames—is proposed to be published periodically, featuring the utility programmes developed at the Structural Engineering Research Centre, Roorkee. The Bulletin is divided in four Sections devoted to specific objects: (i) Modifications to processors and subroutines used on IBM 1620 Computer in either of the languages—SPS or FORTRAN; (ii) Users' instructions along with the write up of the utility programmes developed at the Centre; (iii) Documentation notes and literature surveys on the application of computers to problems in structural engineering and applied mathematics; and (iv) Information on technical interchange-facilities and letters and miscellaneous announcements. It has been reported that the services of the IBM 1620 are available for research institutes and other organization on payment of usual charges.

A copy of the publication entitled, 'Proceedings of the Second Conference on Dimensioning and Strength Calculations', edited by L. Kisbocskoi has been received from the Hungarian Academy of Sciences, Budapest. This contains 46 lectures (from fifteen different countries) delivered at the Conference in 1965 which deal with the various vital problems in the dimensioning of machine parts, steel and light constructions, general design problems, stress and strain analysis, material fatigue and service life, and the problems of brittle fracture.

A copy of the publication entitled, 'Proceedings of the Seventh Conference on the Silicate Industry', edited by B. Beke and F. Tamas has been received from the Hungarian Academy of Sciences, Budapest. This contains a selection of 44 papers presented at the Conference organized by the Scientific Society of Silicate Industry in October 1961 in Budapest. These papers contributed by Hungarian experts and representatives of twelve other countries, cover the entire field of ceramic technology and basic science of silicates.

A copy of the publication entitled, 'Proceedings of the Seventh Conference on the Silicate Industry', edited by F. Tamas has been received from the Hungarian Academy of Sciences, Budapest. This publication contains 14 principal papers read at the Conference organized jointly by the Scientific Society of Silicate Industry and Central Institute of Building Materials Research in Budapest in June 1963 by specially invited speakers, which were supplemented by contributions from other participants. The subjects covered in the publication include structure and physical properties of glass, thermal procedures for investigating silicates, dehydration of clay minerals and zeolites, chemical processes of cement hydration, recent research in the field of oxide ceramics, modern stoping methods in quarrying, modern pressing machinery in refractories, the use of natural gas in firing ceramics, rotary-kiln processes in the cement industry, automation in the silicate industries, modern trends in brick making industry, new refractory materials, light weight ceramic building materials, and high-magnesia Portland cement.

A copy of the publication no. 28, 1965 entitled 'Plastic Designs', has been received from British Constructional Steelwork Association. This brochure gives a summary of the plastic design methods and has been prepared after re-examination of earlier publications (viz., no. 3, 5, 11 covering the plastic design of fixed and continuous beams as well as pinned and fixed base portals in mild steel; no. 21 and 23 dealing with the plastic design in steel and plastic design of columns respectively) of B.C.S.A.

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here.

Shri U. G. K. Rao

Shri Ullal Gopal Krishna Rao, B.E., I.R.S.E., M.I.E., died on September 24, 1966, at the age of 53.

Born at Puttur, South Kanara, in 1913, Shri Rao obtained his degree in electrical engineering from the Mysore University in 1935 and had his training in installation of electrical machinery from the Mysore Electrical Department and the Karachi Electric Supply Corporation during 1935-37. He was also trained on bridge regirdering, design, permanent way and civil engineeing constuction from 1937-39. During 1939-45 he was Resident Engineer of the then G.I.P. Railway and was in charge of the construction of permanent way. After serving as Executive Engineer and Divisional Engineer till 1951, he became District Controller of Stores in 1962. He was appointed as Deputy Director (Soil Mechanics) in 1953 and thereafter as Joint Director Research (Civil) at the Railway Testing and Research Sub-Centre at Lonavla in 1954. During this period he has done considerable research work in soil technology and concrete.

Shri Rao joined the Institution as Member in 1957.

Shri S. Chaudhury

Shri Syamapada Chaudhury, B.E., M.I.E., died in a tragic road accident in New Delhi on September 30, 1966.

Born at Sunamganj in 1912, Shri Chaudhury obtained his B.E. degree in Civil Engineering from the Calcutta University in 1934. He had his apprenticeship training in the Assam Public Works Department for a year and thereafter he was posted as Assistant Engineer. From 1944-54 he worked as Executive Engineer and in 1954 he was promoted to Superintending Engineer, in which position he remained till death. During his career, Shri Chaudhury was responsible for the construction of the Rongandi Bridge, Norai Suspension Bridge, planning flood control works in Assam and for the Umbri hydro-electric project. He had also assisted in the design and construction of the Union Barapani hydel project.

Shri Chaudhury joined the Institution as Member in 1960.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers, It is hoped that employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column, a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

S. N. BANERJEE, B.Sc. (Metallurgy) from Benaras Hindu University, A.M.I.E. (India), Member of the Indian Standards Institution, age 42, having 15 years experience in a big Refractory Works as production executive as well as organiser of modern well-equipped Laboratory (Refractory) with Statistical Quality Control arrangement for the products, seeks a suitable executive post and wants to be posted in Calcutta. (Office ref. E.S. 253)

AGRICULTURAL ENGINEER, 29, B.Tech. (Hons.), M.Tech., A.M.I.E., with five years experience in Production, Design and Development of Agricultural Implements and Tractor Trailers, working with reputed concerns, and ready to serve anywhere; seeks suitable change. (Office ref. E.S. 254)

ENERGETIC and intelligent Civil/Structural Engineer, aged 28½ years, passed Sections A and B (Civil Engineering) of A.M.I.E. (India) securing high marks, passed Graduateship and Section A of A.M.I.Struct.E. (London), having 9 years experience in Drawing and Designing of masonry, R.C.C. and steel Structures including bridges, holding responsible post in Central Government with emoluments Rs. 450 p.m., seeks suitable change in Government undertakings or in big private organization anywhere in India. Also willing to be sponsored for higher studies on service contract. (Office ref. E.S. 255)

SPECIALIZED DIE & TOOL ENGINEER, age 26, possessing First Class Diploma in Mechanical Engineering with distinction marks and passed Sections A and B of A.M.I.E. (India) examinations in Mechanical Engineering, with Production Technology and General Electrical Engineering as optional subjects; having three years experience in Tool Design out of which two years specialization in Die and Tool Design, i.e., Design of Jigs and Fixtures, Press Tools, Cams, Dies, etc., and one year experience in Design of Die Casting, a pressure Die Casting Unit; now doing for Membership Examination of A.M.I. (Prod.) E., (London); seeks suitable, challenging position either in Production Planning, Tool Design or Tool Room in any leading manufacturing concern any where in India; also highly interested to undergo further advanced training either in Tool Design at A.C.M.E. School of Die Design Engineering, Indiana (U.S.A.) or production engineering in any foreign industry or institute on long term service-contract basis with guaranteed bright feature (Office ref. E.S. 256)

YOUNG MECHANICAL ENGINEER, Grad. I.E., age 30 years, possessing Diploma in Mechanical Engineering from the Jamshedpur Technical Institute and passed Sections A and B of AM.I.E. Examination with distinction in Machine Design with Production Technology and Automobile Engineering as optional subjects, having 11 years experience in Machine Shops, Maintenance, Production

Planning and Design, seeks a suitable challenging position in leading industries situated in and around Calcutta. (Office ref. E.S. 257)

QUALIFIED AND EXPERIENCED ELECTRICAL ENGINEER, B.A., Grad. I.E., age 29 years, passed Sections A and B of the Institution of Engineers (India) with Ultra High Frequency Technique including Radar and Centimeter Waves as the special subject, possessing 11 years experience of work on various electrical and electronic equipments including Radar, out of which 3 years experience of organising successfully technical sections independently as Section-in-Charge, possessing high sense of duty, security minded, energetic actions, disciplined nature and leadership qualities, seeks suitable post as an electrical engineer. (Office ref. E.S. 258)

CIVIL ENGINEER, with diving experience, 14 years experience on a multipurpose river project in civil engineering works, holds a responsible gazetted post 4,000 hr. diving done under his supervision, himself can dive in standard suit, already drawing Rs. 700.00 per month, seeks better prospects. (Office ref. E.S. 259)

NEW from PITMAN

Advanced Electrical Power and Machines

G. S. Brosan and J. T. Hayden *100s net*

Assuming only an elementary knowledge of magnetism electrical machines and networks, this work developes the theory in a way which emphasises the physical concepts involved. It thus forms a complementary course to those based on generalized machine theory and should provide a valuable basis for this approach. This book will be found useful not only by students but also by electrical control engineers needing a detailed understanding of the principles and techniques in this field of electrical engineering.

Industrial Management

P. King-Scott *27s 6d net*

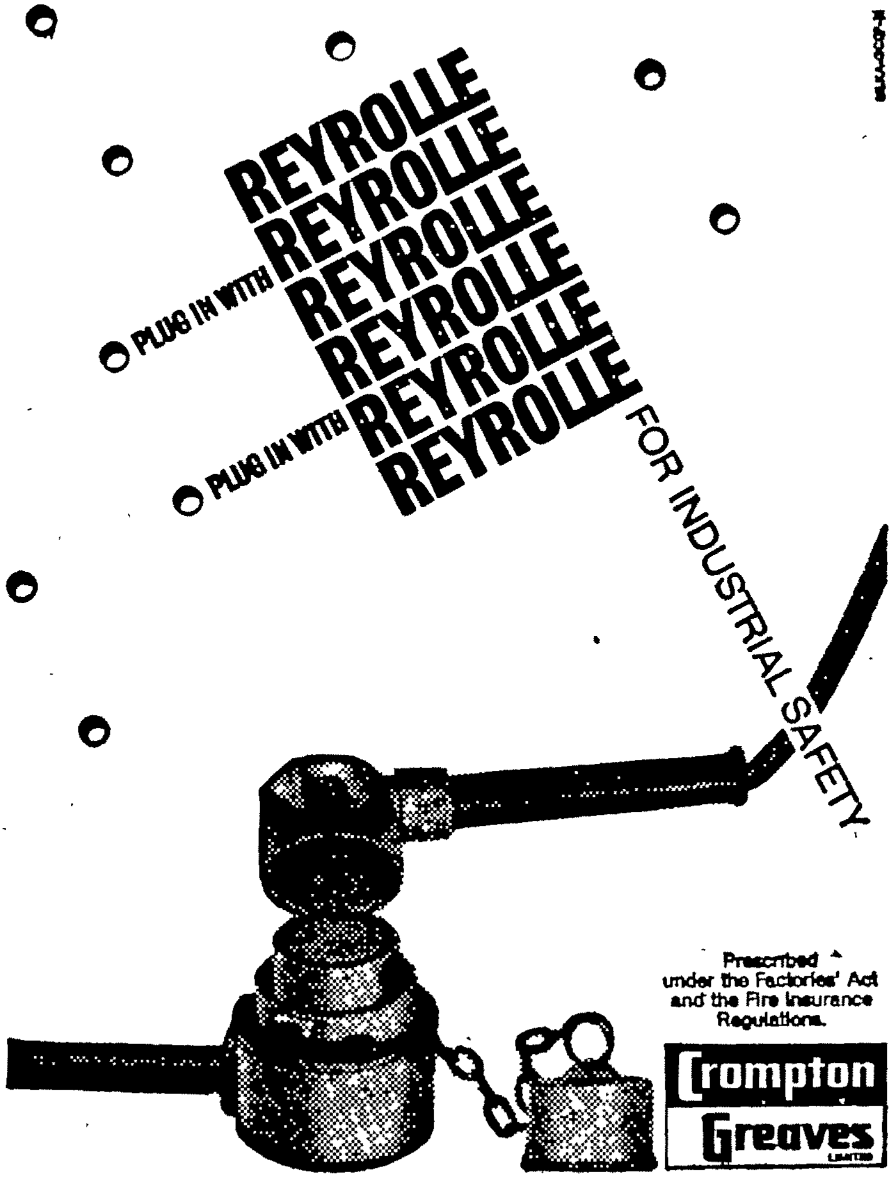
This book has been written for those moving into industrial management and who recognise the need for further study. Specifically it is intended to assist candidates studying for the examinations of the Institution of Mechanical Engineers, Production Engineers and Works Managers. It will be equally useful to middle management personnel taking courses in management, and to students following courses in colleges which include liberal studies. The author is an experienced lecturer in Management subjects.

Thermal Efficiency and Power Production

K. Fenton *40s net*

This book is concerned with the thermal efficiency of power stations, which is the link between the fuel consumed and the effort produced. It deals with the theoretical aspects of power station efficiency, including, on the practical side, the operating factors that can be so decisive in keeping down fuel bills for both turbine and boiler operation.

Published by Sir Isaac Pitman & Sons Ltd., 39 Parker Street London W.C. 2
Agents in India : Wheelers Distributors (P) Ltd., 15 Elgin Road, Allahabad.
also Bombay and Calcutta.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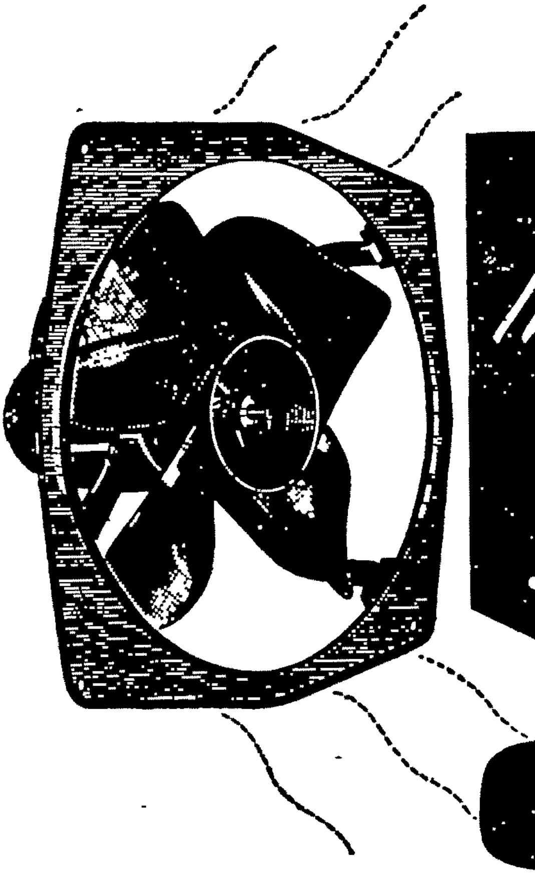

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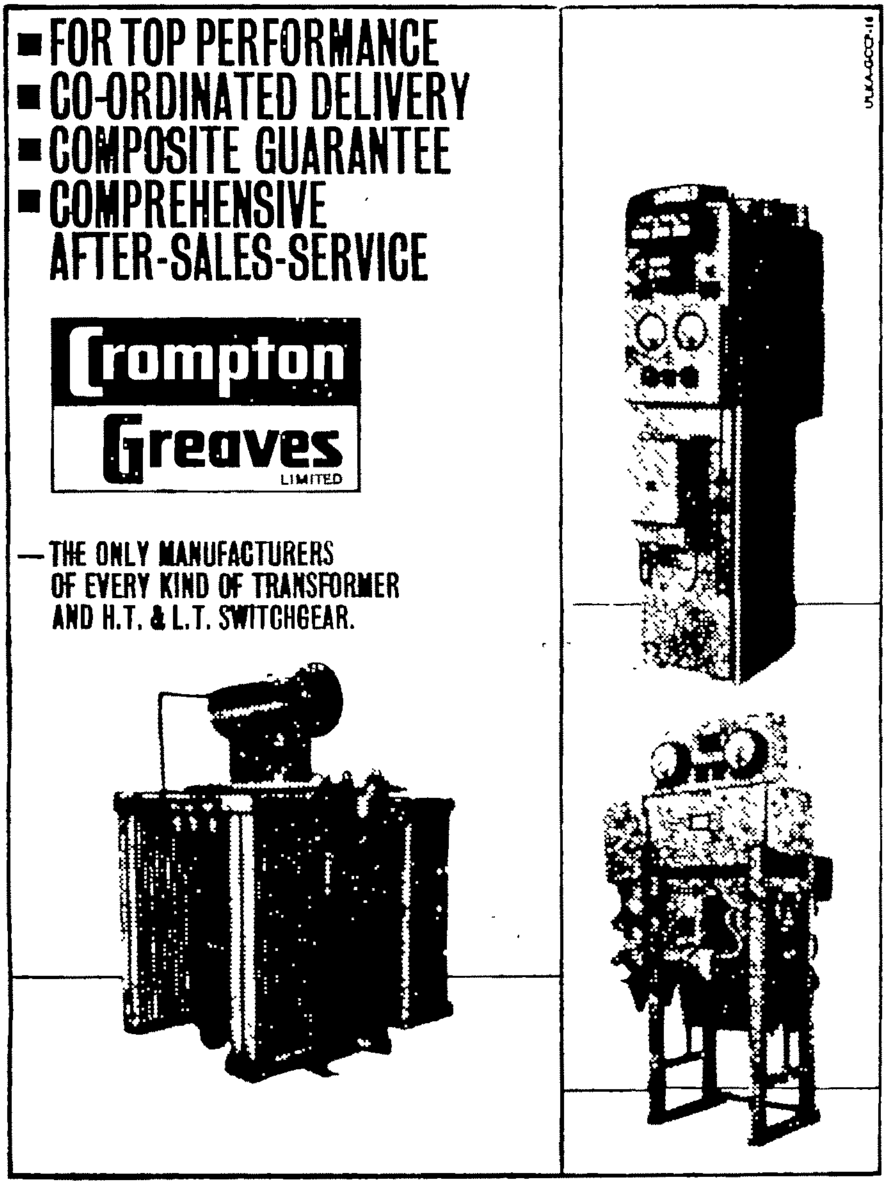

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M. Tex. A. (India), M.I.E. (India)

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SOME MOST USEFUL ENGINEERING BOOKS

1. **PRACTICAL ENGINEERING MATHEMATICS** by Prof. C. Dass Chawla
   (Latest revised and enlarged edition 1966)
   Combined Vol : ... **Rs.** **21.00**
   in Parts : Vol. I & II each ... **Rs.** **11.00**
2. **ENGINEERING DRAWING** by P. N. Vijayvergiya
   (The book is in Metric system and third angle projection. It contains Mechanical, Geometrical and Building Drawings, 2nd edition, 1966) ... ... **Rs.** **12.50**
3. **APPLIED ELECTRICITY** by S. P. Singhal
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UNVEILING OF THE STATUE OF BHARAT RATNA SIR MOKSHAGUNDAM VISVESVARAYA AT HYDERABAD BY THE PRESIDENT OF INDIA ON NOVEMBER 12, 1966

A bronze statue of the late statesman-engineer, Bharat Ratna Sir Mokshagundam Visvesvaraya, was unveiled by Dr. S. Radhakrishnan, President of India, at the Traffic Island on Raj Bhavan Road near the building of the Andhra Pradesh Centre of the *Institution* at Khairatabad, on Saturday, November 12, 1966. The function organized under the auspices of the Andhra Pradesh Centre was attended by a large number of engineers and statesmen in spite of a gentle drizzle which fell all through.

On arrival of the President of India at 10.45 a.m., the National Anthem was played, which was followed by Invocation.

Lt.-Col. R. S. Attre (*M.*), Chairman of the Andhra Pradesh Centre, then welcomed the guests and other invitees. Dwelling on the great role of Sir Visvesvaraya in Indian engineering, he said:

'Today is the proudest day in the history of the Andhra Pradesh Centre, Institution of Engineers (India). Our revered Rashtrapathi, Dr. Radhakrishnan, has very graciously come all the way this morning from the Capital, sparing his most valuable time, to unveil the Statue of Bharat Ratna Dr. Mokshagundam Visvesvaraya. We are extremely grateful and thankful to our Rashtrapathi to do this great honour to the greatest Engineer of our country.

We are privileged to have Shri Pattom Thanu Pillai, the Governor of Andhra Pradesh, amidst us today, having generously consented to preside over the function.

We have no words to adequately thank our most popular Chief Minister, Shri K. Brahmananda Reddy, who has very kindly consented to address the Gathering today. It is mainly because of his kind guidance, help and advice that the erection of this statue at this Island has been made possible. Our sincerest thanks are due to him.

We are very grateful to the Distinguished personages and numerous friends who have sent their good wishes for the function.

We owe a special debt of gratitude to the Mayor and the Municipal Corporation of Hyderabad without whose unstinted support and advice this specially constructed Island for the statue would not have materialised. We are also very grateful to them for very kindly accepting the presentation of this statue after its unveiling at the hands of our revered Rashtrapathi today. We owe our thanks to Shri Mir Akbar Ali Nasiri, the Mayor, Shrimati Sarojinidevi Pulla Reddy, the Ex-Mayor and Shri Ajit Singh, Municipal Commissioner.

We owe our special thanks to Shri K. N. Anantharaman, I.C.S., Chief Secretary to the Government of Andhra Pradesh, who has all the time been our 'friend, philisopher and guide'. He has taken great pains to go into the minutest details of the sitting and erection of the statue apart from all other arrangements connected with this function.

Our thanks are due to several officials of the State Government, Corporation and other organisations who have extended their whole-hearted co-operation in getting this statue erected. Notable among them are: Shri Shravan Kumar, Shri Sayed Hashim Ali, Shri B. V. Ratnam, Shri X. Leema, Shri C. Krishnamurthy, Shri T. Ramachandrarao and Shri Salaamat Ali Khan.

We are also very thankful to Shri B. P. Kapadia, President of the Institution of Engineers (India) and the Council Members for their kind acceptance of the proposals of our Centre and helping us in making today's function a success.

Special acknowledgement of the great work done by Shri Dildar Husain, Hon. Life M.I.E., must be made. He has been guiding us all the time, right from the moment of the idea of erection of the statue was mooted. A special Memorial Volume on the life and work of Sir M. Visvesvaraya has been prepared by Shri Dildar Husain for the occasion after a great research, labour and toil of several years

Our thanks are also due to the kind donors whose names appear at the end. Special mention must be made of Dr. K. L. Rao, Hon. Life M.I.E. It was he, who mooted the idea of erection of a Statue, after delivering the 7th Visvesvaraya Memorial Lecture in 1964 at Hyderabad and donated his remuneration of Rs. 1,000 to start this fund.

I must acknowledge the great work done by Brig. M. K. Rao and Shri V. Parvathesam, the Chairmen of the Centre during the years 1964 and 1965 respectively, under whose guidance this idea took shape and initial work was carried out.

Besides heartily thanking the members of the Visvesvaraya Statue Committee, special mention must be made of the extreme hard work and perseverance of Shri N. Subba Rao, the Honorary Secretary, and Shri K. Naram, Jt. Hon. Secretary of this Centre, who got all the work completed in record time and in the excellent manner which is before one and all.

Shri M. N. Jayaram, Artist of M. S. Nagappa & Co., Madras, deserves not only our special thanks but also our heartiest congratulations for having designed and made this beautiful bronze statue which is being unveiled by the Rashtrapathi today.

Our thanks are also due to Sri B. Anjaiah who took pains to erect the Pedestal in conformity with the design of the Statue.

Our thanks are also due to a large number of our Members and Non-members who have helped in the erection of the statue of Bharat Ratna Dr. M. Visvesvaraya. I will be failing in my duty if in particular the names of the following are not mentioned in this connection: Sarvashri G. A. Narasimha Rao, Guru Pershad, R. M. Patre, M. Seshumadhava Rao, Vidyasagar, Salaamat Ali Khan, Brig. C. L. Sheshagiri and J. V. S. Sastry, the office Superintendent and his colleagues in our office.'

2. Shri B. P. Kapadia, President of the Institution, then addressing the gathering, said:

'Very Revered President Dr. S. Radhakrishnan, Your Excellency the Governor of Andhra Pradesh, The Honourable Chief Minister of Andhra

Pradesh, Your Worshipful Mayor, Honourable Members, Distinguished Guests, Ladies and Gentlemen.

Today is another red-letter day in the history of the Institution of Engineers (India) when the unveiling ceremony of the statue of Bharat Ratna Sir M. Visvesvaraya, the greatest engineer of India, shall be done by the auspicious and august hands of no less a personality than our Philosopher-Scholar and the most revered Rashtrapati Dr. S. Radhakrishnan, the President of India. Sir, we are not unmindful of the fact that this is a special honour conferred on us by you, to have come specially for this function and may I, on behalf of the Institution of Engineers (India), express our deep gratitude and give you a most hearty welcome

This function marks an important landmark in the history of the career of that great Engineer, to do honour to whose memory, we have assembled here this morning.

Sir Mokshagundam Visvesvaraya's association with the city of Hyderabad was the outcome of the cataclysmic flood which took place in the River Musi, on September 28, 1908, when nearly one-half of the city of Hyderabad was destroyed. It caused an enormous loss of life and property. It was a type of flood that had not been witnessed in the city of Hyderabad for nearly a century.

Sir M. Visvesvaraya, who happened to be on leave preparatory to retirement, was touring in France and Italy, when he was approached by the Government of Hyderabad, through the Secretary of State for India, asking him to examine the damage done and to suggest measures to prevent a recurrence of such a catastrophe; he was also requested to prepare a general scheme for future protection of the city from floods, etc.

Sir M. Visvesvaraya arrived in Hyderabad in April 1909, and started operations for the survey of the Musi River to build storage reservoirs in the upper reaches of the river as a means of flood protection and to design a modern drainage scheme etc. for the city. The most important outcome of the advice given by Sir M. Visvesvaraya was the construction of the two large existing reservoirs, namely the Osman Sagar and Himayat Sagar, which were designed by him.

I would not go into the details of his proposals for water supply, modern drainage and the reconstruction of the city, etc. All these details have been described in Sir M. Visvesvaraya Memorial Volume, written specially for the occasion by Shri Dildar Husain, Honorary Life Member of the Institution of Engineers (India).

To keep the memory of this great Engineer green, in 1956 it was decided to institute Sir Mokshagundam Visvesvaraya Lectures to be delivered at the Annual Conventions of the *Institution*

Sir M. Visvesvaraya was not only the greatest Engineer of India, but an international figure in the engineering world. He was the inventor of the flood control gates of Khadakvasla Dam near Poona, and this was patented in his name.

He was made the first Honorary Life Member of our Institution in 1944. He was conferred the highest honour of Bharat Ratna by the Government of India in the year 1955.

Our greatest Engineer, Bharat Ratna Sir Visvesvaraya, had not only proved himself to be one of the greatest engineers but also one of the very able and distinguished Civil Administrators.

Yet such a great man, an eminent engineer, was a very humble and simple man; by his engineering skill, exemplified character, his humility and simplicity, he has set an example to all young engineers.

Though brought up in poverty he had a 'lion's heart'. He believed that service was more important than salary. He wanted to donate Rs. 2 lakhs due to him as the Chairman of the Iron and Steel Works at Bhadravati. He told His Highness, the Maharaja, that people may feel jealous of him if his name was associated with the Occupational Institute; he requested His Highness to give his consent for associating his name for the prosperity of this Institute. This was agreed to by the Maharaja.

He received Rs. 20,000 as fees for his visit to Hirakud Dam; he politely returned it. He insisted on paying a rent of Rs. 250 per month when he was Dewan of Mysore. During the Second World War, rice was scarce. An inspector requested him to sign some letters for getting good rice, as the *bazar rice* was not good. He did not like this; he got up and said, 'I was born poor, brought up poor and I shall eat only the rice, the poor man eats'.

Our Centres all over India have taken steps to keep up his sacred memory and today's ceremony is one of the outstanding tributes paid by our Engineers and citizens of Andhra Pradesh to this great man.

His statue, which will be unveiled today by your august hands, will remind all the thousands-and-thousands of people who will pass by it to recollect his great engineering talents, his greatest contribution in the 'Engineering Science' of India and his shining moral character. It will inspire the youth and the young engineers specially to emulate his deeds.

On behalf of myself and the Institution of Engineers (India) and all those who are present here, I express our deep gratitude and thanks for the trouble you have taken this morning to perform this ceremony.

Our great country has made a name for itself by the preachings of your Philosophy of service to humanity, not only to the Indian Nation, but also to the Nations of the world. Sir, you have brought light and good name to our Mother India, by your scholarly, masterly efforts and in pursuant of knowledge of Religion and Philosophy of life in the international world.

May God give you good health and long life for many many years to come.

I thank the Worshipful Mayor and the Members of the Corporation of Hyderabad for allotting this beautiful piece of land for putting up the Statue and on behalf of the members of the Memorial Committee of Dr. Sir Visvesvaraya and of the Institution of Engineers (India), I present to him this Statue after its unveiling by the Rashtrapati to the safe custody of the great city of Hyderabad.

There is a long list of persons to whom I have to give thanks on this occasion, chief among them are the Hon'ble Chief Minister of Andhra Pradesh, but for whose warm support we would have achieved nothing. I thank His Excellency the Governor of Andhra Pradesh for presiding on this occasion. I also thank for helping in selection of the site, the Chief Secretary, the Deputy Secretary and the Municipal Commissioner and above all the Chairman and the Members of the Committee of the Institution of Engineers (India), Andhra Pradesh, under the leadership of Lt.-Col. R. S. Attre for making this function a great success. Finally, I thank the State Transport Corporation and the Inspector General of Police of Andhra Pradesh and many others for coming to our help and guiding us to make this function a success.

His Excellency the Governor will now request the Rashtrapati to perform the unveiling ceremony.

Thank you'.

3. Shri Akbar Ali Nasiri, Mayor of Hyderabad, recalled the great services rendered by the late Dr. Visvesvaraya for the upliftment of the city of Hyderabad and said:

'It is a very happy occasion that we are honouring today the memory of one of the great sons of India, Late Bharat Ratna Sir Visvesvaraya, an Engineer-Statesman and one of the greatest builders of modern Hyderabad by erecting his statue here in the City. The contribution made by the Late Sir Visvesvaraya to the deavelopment of the City, to the provision of some of the basic civic services which we enjoy today, holds every citizen in deep debt of gratitude to him. The very mention of his name evokes in our minds the tragic memory of the floods to which the city was subjected from year to year—especially the great flood of 1908 which destroyed a major part of the city and from which he delivered the city once for all.

The security of life and property from the ravages of rains enjoyed by citizens on both sides of the Musi River today is on account of the implementation of his recommendations to construct two storage reservoirs on the two arms of the Musi, now known as Himayat Sagar and Osman Sagar. This scheme not only tamed the Musi—the 'river of sorrow' as it was then known—but also provided the city with two beautiful lakes, which, with their gardens and landscape, are amongst the most beautiful places of public recreation in the city. It is also a measure of his greatness that, through these reservoirs, the water which was a 'curse' for the city, was converted into a 'blessing' by using it for the first comprehensive protected water supply system of the city. Thanks to the Late Sir Visvesvaraya, even today, the cost of water supply under this system, which is based on natural gravity flow, is the cheapest in the country.

The underground drainage scheme of Hyderabad was also designed by the Late Sir Visvesvaraya and it is once again a tribute to his genius and foresight that the scheme has worked all these years without any defect and has even catered to the needs of the large industrial expansion that has taken place in and around the city. The contribution, that both these systems —the water supply and the drainage—have made to the general health, and convenience of the public, and sanitation of the city is something that cannot be described in words

The contribution of the Late Bharat Ratna Sir Visvesvaraya to the city is not only that of a simple engineer but of a builder endowed with a rich sense of beauty. It was he who laid the beautiful river-side gardens on the Musi. It was he who conceived the scheme for development of *Imli-Bun* island in the River Musi as a place for public recreation and of building a lake around it. We are happy that we have taken steps, although belated, to give concrete shape to this beautiful dream of his.

Apart from these, he also made substantial contribution to the growth of our civic institutions. His report on the civic set-up is a landmark in the history of growth of our civic body

The debt of gratitude that we owe him is manifold. He was a Statesman, an Engineer, a Builder, a Town Planner and an Administrator and each aspect of his genius has left a mark on the history of the city which neither age nor time can obliterate. We are all proud that we have erected the statue of such a great man in the city, and are grateful to the Institution of Engineers (India) who have sponsored this project.

I am personally very proud and happy to have been given the honour to receive this statue on behalf of the City from the hands of our distinguished President, Dr. S. Radhakrishnan, a philosopher-Statesman and one of the greatest figures of modern times. We are grateful to you, Sir, for the honour you have done to the City to have come here especially for this ceremony. The statue that you would unveil, Sir, would not only be an ornament to the city but a source of lasting inspiration to all citizens. We are also happy that we are having in our midst today another distinguished statesman-administrator in the person of our beloved Chief Minister 'Shri Brahmananda Reddy, under whose guidance this project has taken shape'.

4. Lt.-Col. R. S. Attre then read out the messages received from all over India on the occasion. Of the many, messages were received from Dr Zakir Hussain, Vice-President of India; Smt. Indira Gandhi, Prime Minister of India; Shri C. Rajagopalachari, Madras; Dr. Karan Singh, Governor, Jammu and Kashmir; Shri Jagjivan Ram, Minister of Labour, Employment and Rehabilitation; Shri Swaran Singh, Minister of External Affairs; Shri S. K. Patil, Minister for Railways; Dr. N. Sanjiva Reddy, Minister for Transport, Aviation, Shipping and Tourism; Shri C. Subramaniam, Minister for Food and Agriculture; Shri Sachindra Chaudhuri, Finance Minister; Shri Asoka Mehta, Minister of Planning and Social Welfare; Shri G. S. Pathak, Minister for Law; Shri Morarji Desai, New Delhi; Shri Mehdi Nawaz Jung, Hyderabad; Shri Mehr Chand Khanna, Minister of Works and Housing; Shri J. L. Hathi, Minister of Defence Supplies and Minister of State, Ministry of Home Affairs; Shri O. V. Alagesan, Minister for Petroleum and Chemicals; Shri D. Sanjivayya, Minister of Industry; Dr. K. L. Rao, Minister

of State, Minister of Irrigation and Power; Shri C. R. Pattabhiraman, Minister, Ministry of Law; Shri P. Govinda Menon, Minister for Food; Shri Shah Nawaz Khan, Deputy Minister for Labour and Employment and Rehabilitation; Shri S. Nijalingappa, Chief Minister, Government of Mysore. Shri M. Bhaktavatsalam, Chief Minister of Madras; Shri C. M. Poonacha, Minister of State, Ministry of Transport and Aviation; Shri Nur-Uddin Ahmad, Mayor of Delhi; Shri Ali Yavar Jung, Vice-Chancellor, Muslim University; Shri C. L. Handa, Chairman, Central Water and Power Commission.

5. Shri K. Brahmananda Reddy, Chief Minister of Andhra Pradesh, in a short speech expressed the delight of one and all that one Bharat Ratna (the President) was honouring another Bharat Ratna (Dr. Visvesvaraya). He said the engineers of today would be able to draw much inspiration from the life of Dr. Visvesvaraya.

6. Shri Pattom Thanu Pillai, Governor of Andhra Pradesh, who presided over the function said that during the life time of Dr. Visvesvaraya, he was sought after for help and advice, wherever there was an engineering problem. He also proved to be one of the greatest administrators of modern times He believed in the quick industrialization of the country and took keen interest in the establishment of the automobile and aviation industries in the country though several impediments stood in his way.

The Governor stressed that Dr. Visvesvaraya had also a very high moral character. 'Our engineers and administrators have a great duty to emulate him in this, otherwise this statue will have no meaning', he added.

7. Dr. S. Radhakrishnan, President of India, then unveiled the statue of Bharat Ratna Sir Mokshagundam Visvesvaraya. He said that everyone was trying to secure as much as possible for himself and not looking to the larger interests of the country. 'We may lack in infallibility but integrity we should not lack in', he said.

It was essential that 'Our efforts should be to impress on the people that we are men of integrity. We are not small men'. If there was unrest in the country, 'We should ask ourselves how much we are responsible for it'.

He said that power divorced from responsibility was disgusting. Any kind of political vandalism was not going to build up the country, but going to destroy it. Every one should address to himself, 'Am I helping to build the country or helping to destroy it'.

Dr. Radhakrishnan said that everyone—big or small, high or low, student or teacher, administrator or statesman—should ask himself whether he was doing the right thing for the country. When it was dharma that bound society, they had to ask at every second moment in this critical situation of the country, whether they were contributing to the building up of the country or the disintegration of the country. They had to keep the interests of the country above self and the service to the people above selfish gain That should be the guiding motive.

The President referred to the importance attached to the virtue of character and said: 'Commerce depends on credit, credit in turn depends on confidence and confidence depends on character'. The people should be prepared to build up the country with real character, he added.

Dr. Radhakrishnan paid a great tribute to the Late Bharat Ratna Dr. Visvesvaraya and said that he (Dr. Visvesvaraya) was known for his statesmanlike vision. There was nothing parochial about him. He was born in Mysore, educated in Bombay and worked in different parts of the country. 'Wherever in India we see great schemes of importance, we see his handiwork. Whatever work he undertook, he brought to it his great patriotism and his abundant engineering skill. Everyone remembers Dr. Visvesvaraya as a great man noted for his abiding patriotism, spirit of service and superb engineering skill'.

The President added that Dr. Visvesvaraya's patriotism was evident when he brought out his 'automatic sluice gate', but never asked for a patent or took any royalty for it.

Dr. Radhakrishnan said that Dr. Visvesvaraya had a scientific outlook in all that he did. He did not have any superstitious attitude.

The President referred to the great endeavour made by Dr. Visvesvaraya while he was the Dewan of Mysore, to preserve food grains. More than 40% of the food grains were destroyed by rodents, monkeys and cattle. Dr. Visvesvaraya saw to it that the callous destruction did not take place.

Dr. Radhakrishnan said that Dr. Visvesvaraya's patriotism was evidenced by not only taking any royalty for his automatic sluice gates, but by giving away his earnings for public cause and institutions. He gave to the country what he saved. 'Here is the example of a great patriot, great statesman and great engineer with vision. He worked throughout the country with zeal and patriotism'.

The President said that Dr. Visvesvaraya used his skill and vision as instruments of service and not for self-aggrandisement. 'If we are able to imbibe his qualities, his statue will have served some purpose', he said.

8. Shri Dildar Husain, Hony. Life M.I.E., then wound up the proceedings in a brief speech and proposed a vote of thanks to the President of India and Guests.

The ceremony came to a close at 11.45 a.m. with the playing of the National Anthem.

At 11.50 a.m. the guests were entertained with light refreshment in the premises of the Andhra Pradesh Centre during which the President of India was introduced to the Council Members attending the meeting and the Local Centre Committee Members present. The President of India left at 12 noon.

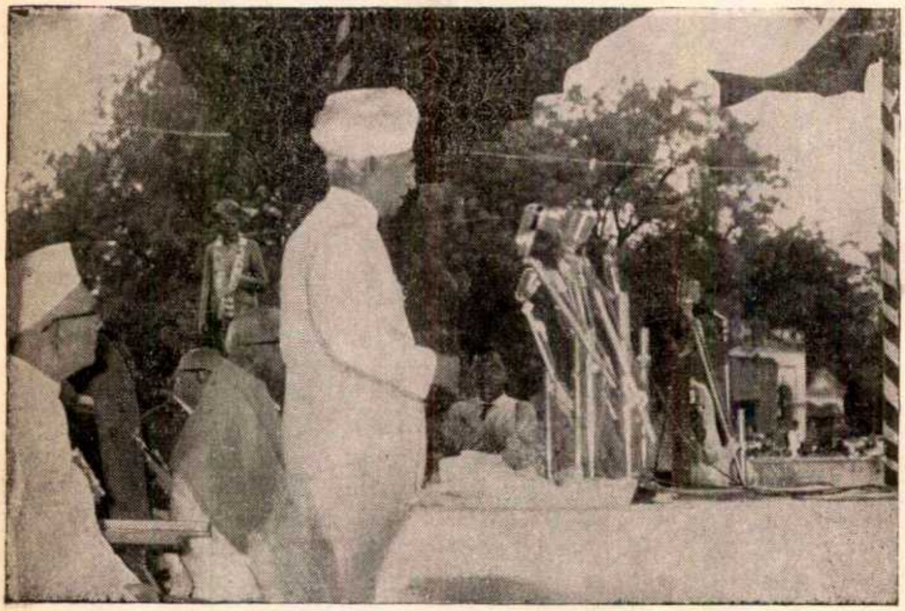
At 8.00 p.m. the same evening the Chairman and Members of the Local Committee of the Andhra Pradesh Centre arranged a dinner party.

A few photographs, taken during the proceedings, are given below.

MEMBERS AWAIT THE ARRIVAL OF THE PRESIDENT OF INDIA

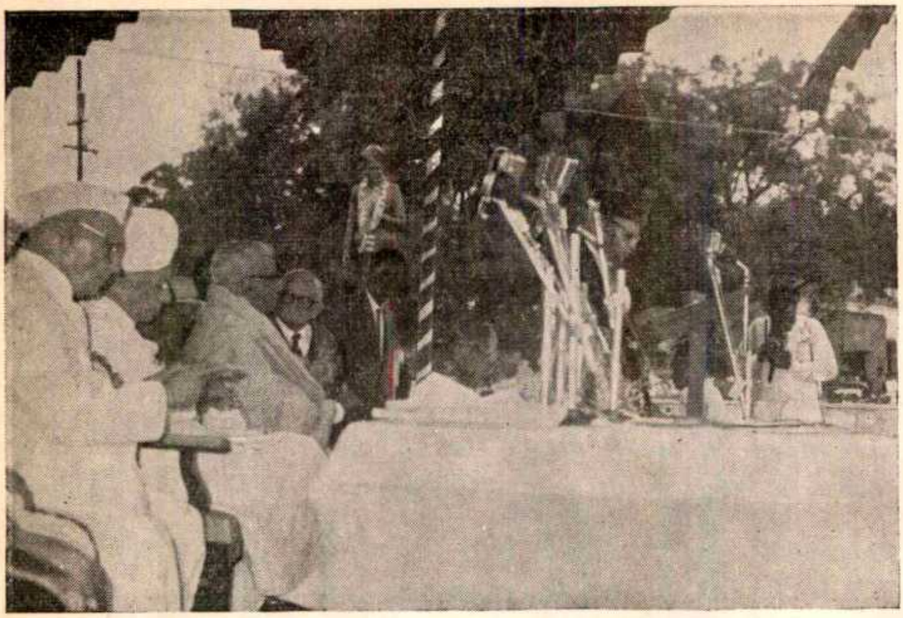
THE PRESIDENT OF INDIA ARRIVES ACCOMPANIED BY DR. K. L. RAO, UNION MINISTER OF IRRIGATION AND POWER

SHRI B. P. KAPADIA, PRESIDENT OF THE INSTITUTION, WELCOMES THE PRESIDENT OF INDIA



DR. S. RADHAKRISHNAN, PRESIDENT OF INDIA, DELIVERING THE ADDRESS

THE BRONZE STATUE OF THE LATE BHARAT RATNA SIR M. VISVESVARAYA
UNVEILED BY THE PRESIDENT OF INDIA



SHRI DILDAR HUSAIN, HON. LIFE M.I.E., PROPOSING A VOTE OF THANKS

THE MEMBERS GATHER AT THE RECEPTION PARTY GIVEN BY THE ANDHRA PRADESH CENTRE

ACTIVITIES OF THE CENTRAL BUILDING RESEARCH INSTITUTE, ROORKEE—A REVIEW

Prof. Dinesh Mohan
Member
Director, Central Building Research Institute, Roorkee

The Central Building Research Institute, Roorkee, has continued to make steady progress since its establishment. As was expected the project orientation of the research programme has yielded useful results and a number of projects have been carried to the stage for direct utilization by the industry. It is a good augury that the industries concerned have taken an increased interest in exploiting the results of the research work carried out at the Institute. The Institute has also been able to expand its area of international liaison by exchange of research programmes and publications. Some of its researches have received international recognition.

The project orientation of research introduced during 1964 has produced good results and considerable progress has been achieved in several research projects which have immediate application in the building industry. Frequent evaluation of each project has helped in maintaining a steady progress. Due to re-allocation of priorities, progress on some basic and long term research projects had to be slowed down to some extent. Restrictions on the appointment of essential staff has also hampered the progress of certain projects.

Significant achievements in the materials side have been the operation of a semi-mechanized brick plant, the development of a ceramic beam roof and the use of light weight aggregates in structural concrete. The development of cement paints and plastic water-proofing coatings deserve special mention, since they have been readily accepted by the industry.

The development and fabrication of indigenous earth-pressure cells has been finalized and the industry has shown keen interest for its production. A recent survey has shown that wide scale adoption of under-reamed pile foundations in shrinkable soils has led to considerable economy in foundation costs. The technique has been included in I.S.I. Code of Practice as well as in the specification of Public Works Departments of Madhya Pradesh and Uttar Pradesh and the Military Engineering Service.

With the computerization of the technique developed for transient thermal response of buildings, it has been possible to predict the indoor climate with greater accuracy. The measurements of sky luminance distribution and solar illumination on horizontal surfaces have provided a convenient basis for the design of daylight through side-lit windows in the tropics. The technique of non-destructive testing of concrete by ultrasonic pulses has been further improved. The slow-speed wind tunnel, designed and fabricated at the Institute, was commissioned and experimental models of buildings were tested for the compilation of design data for ventilation.

The rationalization of specifications for concrete masonry in foundations has indicated a possible saving in the foundation cost. The design and fabrication of a complete prefabricated house has shown that it compares favourably in cost with the traditional construction. The critical path method (CPM) was applied to programming technique for actual building project. A suitable tamping machine for compacting lime concrete roofs has been developed.

On the architectural side, studies on residential densities and land use relationship have led to the formulation of convenient guidelines for the planners. Suitable charts have been prepared for the layout of multi-storeyed housing colonies taking into consideration the various environmental conditions.

Organization of frequent informal seminars on selected topics has provided opportunities for technical discussions amongst scientists of the Institute, the University of Roorkee and other local organizations. The proceedings containing the papers and discussions of such seminars were made available to interested parties. The organization of a Forum on Brick and Tile Industry was of particular significance, since about 40 representatives of the industry had participated and showed keen interest in the utilization of the results of research. A Symposium on 'Changing Concepts of Human Habitations' recently held by the Institute was largely attended including 11 foreign delegates. The demand for technical aid to the industry in the form of consultation services and supply of detail technical know-how on materials and techniques developed has increased considerably. International collaboration has been extended to more countries through the CIB and through exchange of information. The extension services were intensified by arranging extension lectures and discussions at various parts of the country.

A review of the various Laboratories of the Institute and their functions is given below.

(i) Building materials

This Laboratory carries out research on the behaviour and performance of different building materials; conducts basic research on fundamental properties of the constituents of building materials; develops new materials as substitute for imported items; and finds ways of converting industrial wastes and other indigenous materials into useful building materials.

(ii) Soil engineering

This Laboratory concerns itself with problems of soil mechanics and foundation engineering in relation to buildings and allied structures. Field work is often supplemented with laboratory work and model studies to obtain a proper theoretical background.

(iii) Efficiency of buildings

Research in this Laboratory is directed to assessing thermal, acoustical, illumination and ventilation efficiency of various types of building constructions. Determination of conditions that promote comfort and the economical methods of realizing them form a major part of the study. Effort is being made to improve the theoretical and experimental techniques of investigation and these are applied to examine the physical behaviour of materials and building components under different conditions

(iv) Building processes, plant and productivity

Research in this Laboratory is directed towards the study of different building elements with a view to effecting optimum utilization of materials The various building operations are also studied to establish reliable work standards and evolve better and economical methods of construction including design and development of simple mechanical plants and tools to replace manual work.

(v) Architecture

Research work in this Laboratory is mainly oriented to assess the space requirements and performance of different buildings and to furnish essential design data, besides examining the various elements of planning and circulation for achieving greater economy and efficiency with regard to comfort and appearance. This Laboratory also undertakes the design and planning of buildings incorporating new ideas and techniques

(vi) Information and survey

The main functions are the dissemination of technical information from the results of the Institute's research and contacts with 'sister' organizations in the industry. The work has a two-fold character, *viz.*, processing and intergrating technical information for engineers, scientists, contractors and general public and to establish liaison with institutions in India and abroad. Industrial surveys and documentation of literature are some of the functions

(vii) Extension cell

The main functions of the Extension Cell are to obtain the results of research implemented, conducting feasibility studies and trials, market surveys, industrial liaison, demonstration and to carry out formal pilot plant and field trial work

NOTICE

The Central Building Research Institute, Roorkee, is keen on considering the suggestions of practising engineers, contractors, architects and others engaged in the building industry while framing its research programme for the ensuing years. The Institute, therefore, invites proposals for both short and long term research projects. Suggestions with a brief justification for each project with other relevant information which would help in its assessment may kindly be sent to the Director, Central Building Research Institute, Roorkee, before the end of January 1967

WEATHER CONTROL AND RAINMAKING—A PLEA FOR RAIN RESEARCH*

Prof. S. K. Ghose

Member

U.G.C. Research Professor, Patna University

1. Introduction

Man has been trying to modify weather and rainfall since time immemorial and there are frequent references in the *Vedas*, in the book 'The Golden Bough' by Frazer and other sources in which various *Yagnas* and magic rituals have been described for bringing down rains as well as for stopping rains.

2. Historical background

Since 1946, various experiments in local weather modification by cloud-seeding have been conducted throughout the world by more than 50 nations, all of them designed to increase either precipitation, dissipate clouds, suppress hail or lightning or to disperse fogs over airports and harbours. All the advanced countries are vigorously pursuing these experiments and spending money on large-scale researches.

Most of these experiments followed the techniques originally evolved by Langmuir, Schaefer, Vonnegut, Bowen, Dessens, Magoni, Banerji and others. As early as 1933, Dr. Tor Bergeron, a pioneer meteorologist of Sweden, had propounded his theory that substantial rainfall could be released from supercbooled clouds, *i.e.*, having temperature below freezing point, by the introduction of ice crystals inside such highly 'cold' clouds.

On November 13, 1946, Dr. Irving Langmuir and Vincent J. Schaefer, by dropping crushed dry-ice (solid carbon dioxide) pellets from a small chartered plane flying above supercooled clouds over Pittsburg in the U.S.A. created the first man-made snow storm. Soon afterwards Dr. B. Vonnegut discovered that silver iodide nuclei were more effective than natural ice nuclei and as these could be dispersed from generators based on the ground, a new technique was evolved for seeding distant clouds economically. Silver iodide has almost the same crystal lattice structure as ice.

In India, Dr. S. K. Banerji, formerly Director General of Observatories, Indian Meteorlogical Department, carried out successful experiments in 1951 at the Jadavpur University in Calcutta using big balloons for effectively dispersing dry ice, sea salts, silver iodide and ice-cold water to act as the seeding nuclei. Soon afterwards, the author started his rain-making experiments at the Bihar Institute of Hydraulic and Allied Research at Patna and ultimately evolved a simple technique for seeding clouds by means of automatically bursting balloons, sending up finely-ground common sea salt as condensation nuclei. Later on, his technique was successfully demonstrated in 1956 during the great drought in Ceylon, by seeding clouds over the city of Colombo's reservoir at Labugama.

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* Summary of a talk delivered at the Bombay Centre of the Institution of Engineers (India) on August 17, 1966.

Outstanding work in this field has been done by Dr. E. G. Bowen, Director of the Radio-Physics Division of the Council of Scientific and Industrial Research, Australia, who has been a pioneer for carrying out systematic experiments, both inside his laboratories and from his 'Flying Dakota Laboratories' in the air—and even inside the clouds—trying to understand the exact mechanism of rainfall precipitation for inducing more rains over the drought-stricken areas in New South Wales and Snowy Mountain regions.

Scientists in the U.S.A., the U.S.S.R., the U.K., France, China, Japan, Africa, India, Israel, Pakistan, Puerto Rico, Cuba, Spain, Thailand and many other countries have been trying different techniques using such nucleating agents as cupric sulphide, kaolinite, calcium chloride, carbon black (soot), metaldehyde and phloroglucinol for stimulating clouds to give more rains. Startling claims of successes have been made from time to time, but it is now practically agreed that it is possible to increase the natural rainfall by about 20% more, the clouds being seeded whenever their conditions are favourable enough.

More than 3,000 papers published by different workers are now available in several languages which discuss different aspects of the mechanism of cloud formation, development, precipitation or dissipation. Radars, lasers, satellites, planes, balloons, electron microscopes and other sensitive instruments and techniques, as available to the experimenters concerned, are being used.

Realising the tremendous possibilities of weather control, the then President of the United States, General Eisenhower, by a directive of the U.S. Congress, created an expert Advisory Committee of Scientists, Meteorologists, Agriculturists, Ranchers, Cattle Farmers and Businessmen. From January 1954 up till December 1957, this Committee went into the various aspects of weather modification, and analysed the results of experiments already carried out by different agencies. On December 31, 1957, the Committee members submitted their technical reports, and recommendations, in two volumes containing valuable scientific data and suggestions. Its comprehensive bibliography on 'Weather Modification and Cloud Physics', listing 2,259 technical papers, books and publications, is a mine of information. Recently President Johnson has also convened a similar body for exploring the potentialities of weather modification and conservation of water resources including desalination.

In 1954 the Meteorological Society of Japan constituted an Artificial Rainmaking Committee of Japan for carrying out coordinated experiments and researches by scientists of the hydro-electric power stations and universities and even Taiwan started a similar Rain Stimulation Research Institute. The U.S.S.R. and China also started their rain-making experiments at about the same time and are still actively pursuing their trials.

In India, the first Symposium on Artificial Rain-making was held at the Indian Meteorological Department at Delhi in February 1953, and, as a result of its recommendations, the Rain and Cloud Research Unit was set up in 1953 at the National Physical Laboratory under Shri A. K. Roy. Now Dr. K. R. Biswas, Officer-in-Charge of the Unit, is continuing further investigations and experiments. A 3.2-cm. JRC radar is being used for observing distant cloud formations and seeding from planes has been tried over Delhi according to a randomized programme. The State of Madras also has been continuing seeding experiments since 1952 at Coimbatore, Ootacamund and now at Tiruchirapalli.

In September 1961, 40 leading meteorologists and cloud physicists from 15 countries including the author attended the First International Cloud Physics Conference in Australia. In June 1965, a Second International Conference was held at Tokyo where scientists from all over the world reviewed the progress in different branches of Cloud Physics. The papers which were discussed reflected the great advances made in recent years in field of cloud stimulation and the obvious potentialities of weather modification had attracted attention of scientists as well as the public all over the world Some more symposia have been held at Arizona and other places.

In a vast sub-continent like India, climatic and rainfall vagaries are annual features in some region or other in the form of prolonged droughts and/or floods. This year's drought has forcefully reminded all of us that the time is ripe for making all-out efforts to conduct studies, researches and experiments using the most advanced techniques perfected by the pioneer research workers. We have also to prevent or minimize losses due to evaporation from our reservoirs, and we must succeed in tapping the vast reservoirs of water floating above us in the form of rain-bearing clouds, whenever they are favourable.

When our agricultural fields are parched and cracked due to drought or delayed rains it becomes a national emergency measure to utilize the water from all the cumulus and cumulo-nimbus clouds lazily hovering overhead to precipitate their water content and thus could we save our food crops. On these rivers which are not snow-fed as in South India and elsewhere, the big reservoirs get depleted, and the author would suggest that only by timely cloud seeding could we economically augment out water reservoirs by tapping all storms which would otherwise move on or dissipate without precipitating their water-load over such catchments. Routine cloud-seeding from planes, etc., have already become routine practice in Canada, Japan, the U.S.A. and Israel. There is no reason why India should not exhibit supreme action over this vital problem

In April 1962, Pandit Jawaharlal Nehru in a letter to the author gave his considered opinion on this subject when he stated 'I was a little disappointed to find that all the efforts in other countries notably in Australia, and, I think, in the United States, had not yielded any adequate results. That of course does not mean that we should not continue with this research work. With regard to the possibilities of rain-making, it would certainly be desirable to have this research done on a wider scale.'

No doubt, the Central Board of Irrigation and Power, as an authoritative body having control over so many research stations in the country, is one of the active organizations which could stimulate and coordinate further studies and researches in this field. The Agricultural Research Stations, the State Electricity Boards, Irrigation Departments and the universities could also actively help and collaborate in this vitally essential work affecting 45 crores of our people who have been practically forced to beg for 'Food Ships' and subsisting on foreign loans.

SAFETY IN ENGINEERING

Maj.-Gen. R. A. Loomba
Member
Convenor, Panel on Safety in Engineering

General

1. Safety has become synonymous with existence. Almost in every walk of life, in every action of human being, safety plays an important role.

Safety in engineering includes a combination of the allowances necessary to be made in the use of practical data including allowance of the lack of precision with which certain conditions can be ascertained. Safety factors in engineering have a rational basis which become more apparent as the conditions which govern the factors become known. Further, there is safety in operational and maintenance procedures, in prevention of accidents, in inspection methods and every phase of engineering activity.

In order to keep the members of the Institution of Engineers (India) informed of the latest developments in the field of safety in engineering and to make a study of one or more aspects of selected subjects, the Panel on Safety in Engineering was constituted in May 1965.

Aim

2. The aim is to find specialist authors to write articles on the latest developments in the field of safety in engineering in the country. For the present, the following subjects have been selected for study and publication of articles :

(a) Safety in Civil Engineering
(b) Safety in Electrical Engineering
(c) Industrial Safety
(d) Safety in Mining Operations

It is also proposed to collect, collate and publish the advancements already made in the country in the field of safety in engineering by various organizations. A study of the work that is being done in the field of safety in engineering by the following organizations has been made :

(a) Various committees on Safety of the Indian Standards Institution
(b) In the field of Industrial Safety, by the Directorate General of Factory, Advice and Service and Labour Institutes

Organizations such as Ordnance Factories and Railways have also been requested to contribute papers on the safety aspects of engineering and operations.

Civil Engineering

3. In planning and designing of every civil engineering work—whether it is building, road, bridge, dam, highway or other engineering structure, the following three aspects of safety are of paramount importance :

(a) Structural Safety
(b) Constructional Safety
(c) Fire Safety

Assessment and appreciation of the problem

Structural safety

4. With the industrial and all-round development in the country in the post-independence period, the constructional activities have increased considerably with the result that the problem of safety and at the same time economical design of structures has assumed very great importance.

5. Safe and sound construction of any project is a preliminary requirement and the problem has assumed special significance in the context of extreme shortage of building materials in the country and the speed with which various projects are required to be executed to fulfil the targets laid down. These factors have brought increased responsibility on structural designers, engineers who are required to design and construct the structures not only to ensure their structural safety and thereby reduce hazards to life and property but also to eliminate the avoidable wastage of materials and labour

Constructional safety

6. With the rapidly expanding constructional activities in the field of civil engineering, the construction industry is becoming more and more conscious about the need for proper and adequate measures for ensuring the health and safety of the workers engaged in the construction.

7. Mechanization of various operations involving mechanical devices and power-driven machinery has vast complex hazards and brought in new problems for the management to ensure safety of the workers. In view of the hazards involved in construction, safety in construction has assumed greater importance. Consolidated figures relating to the accidents in construction are not available, though a large number of accidents are taking place during construction.

8. Whilst some attention is being paid to the accidents in factories and mines, no systematic and organized effort has been made to reduce the risk of accidents during construction. Statistical records are also not available to indicate the number of accidents in order to highlight the seriousness of the problem.

9. Hazards during construction are well-known and these are nearly as those in the regular factories except certain special hazards, as in excavation work, tunnelling work, compressed air work and demolition work.

Fire safety

10. A large number of cities and towns in our country have grown very rapidly in industrial field with the result that fire hazards and rescue problems have increased. It has been noticed that in planning and layout of various new industries, adequate attention is not being given to the basic aspects of fire safety such as fire prevention measures, provision of water-supply arrangements and provision of first-aid fire fighting arrangements. The strength of fire fighting, power and fire service organizations has not kept pace with those increased hazards and rescue problems that result in serious fires involving colossal waste of money. If the aspect of fire safety in the existing buildings and in the planning and designing of new industrial

and non-industrial buildings is not tackled properly, we may be faced with several disastrous fires accompanied by loss of human life and property

11. In this field also, complete statistics relating to fire loss are not available and it is estimated that annual loss on this account is Rs. 5 to Rs. 10 crores in respect of insured risks. All aspects of fire safety are to be examined and the risks minimized by giving adequate attention to this work right from the planning stage upto the final stage of completion by providing and maintaining adequate fire fighting equipment

Electrical engineering

12. Safety aspects involved in the generation, transmission and distribution of electricity, safety precautions in high voltage electrical installations and lines, any legislative acts for the safety and its enforcement require detailed study.

Study of work done in the country by other organizations

Indian Standards Institution

13. A great deal of work has been done by the Indian Standards Institution on the safety aspects and several standards have been published which give very useful guidance. It has formulated safety codes for excavation work, compressed air work, use of scaffolds and ladders laying down all the requirements which are necessary for ensuring safety of workers. The Fire Safety Committee of the I.S.I. has also issued a number of Codes of Practice for fire safety of buildings convering general principles of fire grading, materials and details of construction, exposure hazard, personnel hazard, electrical installations, fire fighting equipment and maintenance.

14. A summary of the various Indian Standards on safety aspects of civil engineering and the drafts which are under preparation is given at the Appendix which will give interesting information regarding the progress made in the safety aspects of engineering

Directorate General of Factory Advice and Service
Industrial safety

15. A President's Conference on Industrial Safety was organized by the Ministry of Labour and Employment with the cooperation of the management associations in Delhi during December 1965. There were six working groups that took part in the deliberations and their report is given hereunder

Setting up of National and State Safety Councils

16. Safety is a responsibility of management with active and full cooperation of workers and with the sanction and support of the Government

17. The general consensus of opinion was to form a National Safety Council. It was recognized that safety in engineering is a full-time profession which should not be combined with other functions and that there is a necessity for development, training and employment of Safety Engineers in different industries throughout the country.

18. The proposed National Safety Council should be an autonomous self-regulating body independent of direct government control. The structure of the Council should include representatives from industry, management,

National Productivity Council, Employees State Insurance Corporation, Factories Inspectorate and Labour Unions. The Council should confine to engineering aspects of safety, provide materials for safety education and also suggest to the government enforcement that should be necessary towards industrial safety.

19. A scholarship scheme through which selected students can avail of the opportunities of studying in foreign universities towards specialization on the subject of industrial safety was also suggested. The Council should provide training courses in safety in close collaboration of some educational institutions in the country.

20. There was a consensus of opinion in favour of setting up of National and State Safety Councils since the responsibility of safety lies with the management, labour as well as Government. The details of the form of the National and State Safety Councils might be left to be worked out by the ministry concerned on a tripartite basis

Occupational Health Services at places of employment

21. The responsibility for the worker's health lies not only with the worker himself, but also with the employer, the Government and the Trade Union.

22. Health education is very essential and trade unions have an important role play in this. The employers can only enforce the improvement of working environments and the preventive measures recommended by the doctors.

23. Occupational health problems comprise of examination of the worker himself and examination of his working environment. The Employees State Insurance Corporation should play more effective role in fulfilling the objective of the occupational health services with more sharing of financial responsibility. There was unanimous agreement on the need for occupational health service at places of employment on the lines indicated in the reporting of the W.H.O. and I.L.O. Regional Conference on Industrial and Occupational Health held in Calcutta in November 1958. There was also unanimous agreement on the need for statutory enactment for provision of this type of occupational health service.

24. The management alone was to set up and carry on the functions of the occupational health service but statutory provisions were envisaged

Safety in iron and steel industry

25. The hazards in material handling, crane accidents, accidents in the rolling mills, gas accidents as well as accidents in railway operation within the factory were dealt with. Several preventive measures were suggested to avoid accidents in material handling.

26. The importance of safety courses and practices in preventing crane accidents and its rigid enforcement at the shop floor were emphasized.

27. Another important source of danger which is particularly formidable in the iron and steel industry is 'Gas'. The production of a gas is inseparable from the basic operation of the industry. There are two dangers from the

two main gases—blast furnace gas and the coke oven gas. One is gas poisoning and the other explosion. Blast furnace gas is more dangerous because of the higher percentage of carbon monoxide. Though it is not possible to keep all areas in a steel plant absolutely free of gas always, they could be controlled by incorporating safety features in the plant designed. Gas masks with incorporated breathing appliances were recommended as a necessary adjunct in the plant working.

28. In regard to accidents occurring during railway working in a iron and steel plant, it was suggested that provision of subways and over-bridges at busy points would minimize the accidents.

29. As regards the personal protective equipment, it was felt that the National Safety Council should take up the question of designing suitable protective equipment particularly for eye protection and encourage Indian manufacture. The important 'must' in accidents prevention work is training, education and arousing of safety consciousness amongst all levels from top management down to the worker.

30. It was concluded that safety was essentially a human problem in which the entire human force of the industry was directly or indirectly involved. Accidents occur mainly due to human failures and human neglect. The National Safety Council will have to tackle the problem of safety from the wide human angle not only by laying down in specific terms the responsibilities of each sector of men working for or in the industry but also by devising tools and methods by which the men will be induced or motivated to discharge those responsibility. The Safety Cell has to be engaged in continuous research for newer methods and approaches to meet the challenge of newer technological developments and consequent human attitudes and in order that it may make an impact, the chief of the safety department must be a man of vision, initiative and leadership and should be clothed with adequate authority.

Safety in textile industry

31. A large number of preventible accidents occur in spinning and weaving departments, the cost of accidents being heavy both for employers and the employees. Lighting and ventilation are equally important factors in relation to accidents. It was concluded that research institutes such as TIRA, BTRA, and SITRA could usefully investigate remedies for preventing accidents due to bobins and shuttles. Education and training of workers was of prime necessity in any safety programmes.

32. Statistics indicated a rise in accidents after the introduction of Employees State Insurance Corporation scheme.

Safety in engineering industry

33. It was stressed that safety is as much a specialized field as personnel management, machine maintenance or any other aspect of industrial and commercial activity. The Safety Officer should be well qualified. To make the establishments more safety-conscious one of the ways would be to have a separate safety department with competent personnel which will be directly responsible to the management and will function both in an advisory capacity

for advising the parties concerned about the proper precautions and steps to be taken and as an executive authority for getting this implemented. While it was felt that there should be a statutory provision for appointment of safety officers whether it should be linked to the number of persons employed in the organization or whether it should be related to the hazards present in the industrial establishment was discussed and it was suggested that the number of safety officers be statutorily appointed in a restricted group of industries could be linked up with that of the number of employees. Exemptions, etc., if necessary, would be decided according to the individual merits by the factory inspectorate concerned.

Chemical industry

34. It was emphasized that there were hazards affecting the general health of workers in chemical industry. These in particular affect the respiratory system, blood forming organs, nervous system, kidneys and skin.

35. Improvements in the working conditions, proper maintenance of machinery and introducing engineering devices would save a lot of damage. The absence of any reliable statistics regarding incidence of occupational diseases arising out of work in chemical industries was a glaring deficiency. There was general agreement that there was a great necessity to study the different hazards arising out of more and increasing use of chemical in our present day industries and which are likely to come up in future. These hazards have got to be listed and classified accordingly as per recommentions made by I.L.O. into six different categories for which a reference would be made to their publication. Safety equipment are necessary to combat some of the hazards which could not be adequately controlled as a result of process and in order that these equipment are effective a certain amount of evaluation and standardization was also necessary. An expert body should go into the question of studying the facts of various hazards on the health of workers working in the industry, the nearby community and also the consumers. This expert body should work in close cooperation with existing bodies who are tackling the problem at present. The need for collecting statistics on accidents and specially for chemical industries was stressed. The Chief Inspector of Factories may be able to organize this more effectively than at present.

Articles published

36 The following articles have been published in the Journal of the Institution in the field of mining.

(a) 'Promotion of Safety in Mines' by G. S. Marwaha

(b) 'Disasters in Mines: Comparative Study of Occurrences and Prevention' by G. S. Marwaha

With the rapid progress in mining industry in India the problems of safety precautions and healthy environment of worker should receive more attention. The problems of safety and health in mining operations require an analysis and legislative and educative measures to overcome. An analysis of the causes which lead to the mining disasters, an assessment of the hazard in the mining industry and the prevention measures adopted to reduce accidents have also been covered in the above articles.

An article on 'Safety in Construction and Use of Hill Roads' is being published shortly for the information of members

Recommendations of the Panel

37. For the purpose of ensuring safety in engineering, it is very essential to lay down safety standards in each field and enforce them by law

In order to ensure the safety of the worker, it is essential that safety education be enforced. A scholarship scheme through which selected students can avail of the opportunities of studying in foreign countries towards specialization in industrial safety should be implemented. Training courses in safety in close collaboration with educational institutions should be organized.

As safety in engineering is a full time profession, there is a necessity for development, training and employment of safety engineers in different industries throughout the country.

Ways and means should be found to ensure that organizations connected with safety in engineering keep the Institution informed of their activities and developments in the field.

Ways and means should also be found for collection and collation of statistical data in respect of all accidents that take place for want of safety precautions

Appendix

Summary of various Indian Standards on Safety in Civil Engineering

Structural safety

1. *I.S.: 875-1954 Code of Practice for Structural Safety of Buildings: Loading Standards*

This Code covers basic design loads to be assumed in the design of buildings. Dead loads, loads due to partition walls, live loads on floor and roofs, loads due to snow and rain, horizontal loads on parapets and balustrades and wind loads are specified. The effects of impact and vibration, soil and hydrostatic pressure, erection loads and combinations of different categories loads are also briefly covered.

Two detailed wind maps of India, one giving basic maximum wind pressures including winds of short duration and other giving basic maximum wind pressures excluding winds of short duration are included in the standard.

The imposed loads including wind loads specified in the standard are minimum working loads which should be taken into account for purposes of design. The code does not take into consideration loads incidental to construction and special cases of vibration such as moving machinery, heavy acceleration from cranes, hoists and the like. The Code recommends that such loads should be dealt with individually in each case.

2 *I.S.: 1904-1961 Code of Practice for Structural Safety of Buildings: Foundations*

This Code lays down the requirements for structural safety of foundations for buildings. Various terms used in foundation design and different categories of soil have been defined. General design considerations and the factors influencing design of foundations such as loads on foundations, allowable bearing pressures, safe bearing capacities of various types of soils, settlement, methods of finding bearing capacity by calculation, stability against over-turning and sliding are discussed. Conditions affecting the depth of foundations are discussed and formulae and design methods for different types of foundations such as spread foundations, spread footings of masonry and concrete, strip foundations, steel grillage footings, raft foundations, pier foundations, pile foundations, etc., are briefly covered

Precautions during and after construction of foundations and methods of determining allowable bearing pressure are briefly covered. Maximum safe bearing capacity for rocks, non-cohesive soils, cohesive soils, peat and made up ground has been specified. Appendices are included for guidance and selection of types of foundations and for computation of bearing capacity for sheer failure of soils of known characteristics

3 *I.S.: 1905-1961 Code of Practice for Structural Safety of Buildings Masonry Walls*

This Code gives structural recommendations for both load bearing and non-load bearing masonry walls. Effective thickness and effective height of the walls as well as the effects of slenderness have been discussed and reduction factors for allowable compressive stress in walls with different slenderness ratios have been recommended. Maximum permissible compressive stresses on walls of bricks or blocks of different strengths and constructed in different mortars have been specified. Tables recommending the minimum thicknesses for external and partly masonry walls of residential, business and industrial buildings are included. Recommendations regarding minimum thicknesses of walls when mud mortar is used in place of cement or lime mortar have been given. The minimum thicknesses and other essential design requirements for cavity walls are also recommended.

Safety in construction

4. *Safety Code for Working in Compressed Air (Preliminary Draft Standard)*

This Standard lays down the safety requirements for work in compressed air undertaken in construction of foundations of bridges, docks, tunnels, etc. The standard also gives recommendations regarding equipment to be used for compressed air work, duties of the attendants of the locks, agrees from the working chamber, temperature in the working chamber, employment restrictions, medical supervision and certification, medical locks, supply of hot drinks, detection of gas and rules for compression and decompression.

5. *Safety Code for Excavation Work (Preliminary Draft Standard)*

This Standard lays down the safety requirements for the excavation work in trenches, test pits, cuttings for rail and road formations and all excavations on which the sides of the cut are not trimmed, simultaneously, to a stable slope.

Recommendations regarding shoring and timbering, *berams*, fences and guards, provisions of flares or lanterns, use of safety rope, temporary supports and walk-ways are given. Precautions against harmful gases and fumes, overhangs and slopes, power showels, vehicles, tools and other common hazards in excavation are given.

6. *Safety Code for Scaffolds and Ladders: Part 1—Scaffolds (Preliminary Draft Standard)*

This Standard lays down the safety requirements for the use of various types of scaffolds for supporting workmen or materials for any construction work including maintenance and demolition.

7. *Safety Code for Scaffolds and Ladders: Part 2—Ladders (Preliminary Draft Standard)*

This Standard lays down safety requirements for various types of ladders, used for the various jobs in general construction work including maintenance and demolition.

8. *Safety Code for Blasting and Drilling Operation (Preliminary Draft Standard)*

This Standard lays down safety requirements for blasting and drilling operations with detailed reference to transportation, storage and use of explosives, drilling and loading procedures, tamping, shorting with fuse, underground work and precautions to be observed before and after firing and disposal of explosives.

Fire safety

9. *I.S.: 1641-1960 Code of Practice for Fire Safety of Buildings (General): General Principles and Fire Grading*

This Code covers the general principles of fire safety of buildings, fire grading of buildings and general fire safety requirements for structural components in buildings. Classification of fire hazards, fire loads and materials which may cause fire hazards; calorific values and flash points of the hazardous materials; list of abnormal occupancies and fire resistance tests of structural components are covered in detail.

10. *I.S.: 1642-1960 Code of Practice for Fire Safety of Buildings (General): Materials and Details of Constructions*

This Standard lays down the essential requirements of fire safety of buildings with respect to materials used and details of construction. The constructional details and materials of construction for structural components like walls, columns, beams, floors, roofs, ceilings, stairs and staircases, doors and windows to ensure their protection against fire hazards are recommended. Minimum thicknesses and fire grading for different types of walls and partitions are recommended. Thickness of protection for steel columns and beams and fire resistance of R.C.C. columns are also discussed. Requirements regarding ventilation, window openings, exit openings and other such factor affecting the fire safety of the building and its occupants are covered.

11 *I.S.: 1643-1960 Code of Practice for Fire Safety of Buildings (General) Exposure Hazard*

This Code gives recommendations regarding minimum spacing, orientation and size of buildings and protection of existing buildings to provide adequate safety against exposure to fire hazards.

12. *I.S.: 1644-1960 Code of Practice for Fire Safety of Buildings (General): Personal Hazard*

This Code lays down the requirements for fire safety of buildings with respect to personal hazard. Requirements regarding construction and layout, details of escape routes, construction, layout and minimum width of staircases and their discharge values and restrictions on single staircase buildings for urban areas where attendance by the fire service can be expected. are given. A separate appendix for determining staircase widths and their discharge values is also given.

13. *I.S.: 1645-1960 Code of Practice for Fire Safety of Buildings (General): Flues, Flue Pipes and Hearths*

Requirements for fire safety of buildings in respect of chimneys, flues, flue pipes, hearths and their functional requirements and materials of construction are recommended.

14. *I.S.: 1646-1961 Code of Practice for Fire Safety of Buildings (General): Electrical Installations*

This Code covers rules and regulations relating to electrical equipment of buildings required from the point of view of fire safety and deals with power equipment, switch boards, power distribution and motor control gear transformer substations, earth connections, wiring, lighting, electrical appliances and equipment, requirements in the case of specific uses and testing. Requirements for specific uses include the recommendations concerning electrical equipment and installations for godowns, strong rooms, lifts, cranes and hoists, chemical factories, petrol stations and liquid fuel tanks, theatres and public places of entertainment, film storage rooms, factories including film laboratories and film storage rooms.

15. *I.S.: 1647-1960 Code of Practice for Fire Safety of Buildings (General). Non-Electric Lighting Equipment, Oil and Gas Heaters and Burners of Small Capacity*

This Code covers fire safety requirements in respect of non-electric lighting equipment, such as hurricane lanterns and pressure lamps using oil or alcohol vapour. It also lays down fire safety requirements for certain domestic heating equipment, such as oil or gas fired heaters, cookers and boilers of average domestic size. Fire safety precautions in respect of open or exposed flame appurtenances that may be met with in buildings are also prescribed.

The intensity of lighting and choice of type of lighting, heaters and burners for particular applications are not covered in this standard

16. *I.S.: 1648-1960 Code of Practice for Fire Safety of Buildings (General): Fire Fighting Equipment and Its Maintenance including Construction and Installation of Fire-Proof Doors*

Part 1 of this Code covers the requirements and maintenance procedures for fire fighting equipment such as automatic sprinkler installations, hydrant services and hand appliances.

Requirements concerning buildings to be protected with sprinklers, spacing of sprinklers, protection of concealed spaces, hoists, elevators, gear boxes, water supply system for the sprinklers are covered in detail. The Code recommends that automatic sprinkler installations are intended to be, in addition to, not in substitution for, other fire extinguishing appliances which should also be provided and maintained in perfect working order. Recommendations regarding installation and maintenance and use of hydraulic pumps, elevated tanks, hydrants, fire box and other service equipment, hand appliances comprising water and sand buckets and chemical extinguishers are given. Detector systems are also broadly covered.

Part 2 of this Code covers the materials, construction and installation of fire-proof doors of the following types:

(a) Iron and steel doors
(b) Metal covered doors
(c) Rolling steel shutters

17. *I.S.: 2406-1963 Code of Practice for Fire Safety of Non-industrial Buildings*

This Code covers the fire safety requirements of non-industrial buildings with special reference to residential buildings with special reference to residential multi-storey buildings, hotels, boarding houses, restaurants and similar establishments; schools and buildings used for educational and/or training purposes; hospitals, nursing homes, sanitoria and asylums; buildings for devotional congregations; public halls, museums, art gallaries, public libraries and similar buildings; commercial offices, banks and government offices; club houses; auditoria, theatres and cinemas; retail shops and emporia and laboratories.

18. *I.S.: 2726-1964 Code of Practice for Fire Safety of Industrial Buildings: Cotton Ginning and Pressing (Including Cotton Seed Delintering) Factories*

This Code lays down the fire safety requirements for cotton ginning, cotton seed delintering and pressing factories, with special reference to the location and construction of the buildings, separating walls, compounds, godowns, machinery, electrical installations, illumination, fire-fighting arrangements and housekeeping.

19. *I.S.: 3058-1965 Code of Practice for Fire Safety of Industrial Buildings: Viscose Rayon Yarn and/or Staple Fibre Plants*

This Code lays down the fire safety requirements for plants manufacturing viscose rayon yarn or staple fibre or both, with special reference to storage arrangements for coal, sulphur carbon disulphide and fuel oils ; constructional features of the buildings; installation of main plant, boiler plant, carbon disulphide plants and sulphuric acid plant; electrical installation; illumination; fire-fighting arrangements and general safety provisions.

20. *I.S.: 3079-1965 Code of Practice for Fire Safety of Industrial Buildings: Cotton Textile Mills*

This Code covers the essential requirements for fire safety of textile mills, using cotton, cotton waste, regenerated cellulose, man made fibres or any grouping of these as raw materials. Special reference has been made regarding the building construction, compounds, separating walls, mechanical and electrical installations, fire-fighting arrangements, illumination and general safety provisions.

21. *Code of Practice for Fire Safety of Industrial Buildings: Electrical Generating and Distribution Stations (Draft Standard)*

This Code lays down fire safety requirements for electrical generating and distributing stations which derive their power from steam, water or combustion of Diesel oil but not those which use atomic energy for their operation. Detailed recommendation regarding building construction; separating walls; storage arrangement for coal and fuel oil; coal, oil and gas fired installations; prime mover and generating plants; switchgears, circuit breakers, busbars and storage batteries; illumination; fire-fighting arrangements and housekeeping are given

22 *Specification for Fire-check Doors (Draft Standard)*

This Standard gives specifications regarding materials and construction of fire-check doors to restrict the spread of fire within buildings whether from internal fire or from external fire.

This standard also gives details of construction and installation of iron and steel doors, metal covered doors and rolling steel shutters and their marking.

23 *Code of Practice for Installation of Internal Fire Hydrants in Multi-storey Buildings (Preliminary Draft Standard)*

This Code lays down the requirements regarding installation of fire hydrants in multi-storey buildings of the following heights: (a) from 15 to 24 m.; (b) from 24 to 60 m , and (c) above 60 m.

This Code also gives types of hydrant installations, and criteria for their selection and location with details of pipes and hoses, tanks, emergency water supply connections, hydrant pumps, fire brigade inlets and their sizes, number, location and fitting and testing.

24 *Code of Practice for Fire Safety of Industrial Buildings: Aluminium Powder Factories (Preliminary Draft Standard)*

This Code lays down the requirements for fire safety of aluminium powder factories with details regarding layout and construction of factory, storage of aluminium powder, mechanical and electrical installations, illumination, fire-fighting arrangements, housekeeping and safety provisions.

THE FRUIT OF ELEVEN-YEAR COOPERATION

Oleg V. Malugin

Non-member

Unesco Expert

Indian Institute of Technology, Bombay

1. Introduction

India is a very good example of an active cooperation of different countries with the framework of the United Nations. At present, more than 20 expanded projects are being accomplished in India with the help of various U.N. specialized agencies, financed by the U.N. Special Fund. UNESCO is responsible for bringing into life some of them, including the Indian Institute of Technology, Bombay.

There has been written such an abundant pile on the Indian Institute of Technology, Bombay, that any new article can hardly aim at covering every aspect of the Institute's life for otherwise it would immediately turn into a multipaged academic treatise.

2. Background of engineering education in India

Before the Second World War most of the Indian engineers and technicians were getting their training abroad though the first college dealing with technical education in India was established well over a century ago. In the post-war period it was, however, realized that there was an urgent need for establishing of technical facilities within the country to meet the requirements of higher technical education. Already in 1944, in the Sargent Report the necessity of developing technical education was pointed out and the need for broad scientific training and close links between educational establishments and production shops was stressed.

3. New trend in technical education

Some years later another important decision was taken by the Central Government, namely, to establish four higher technological institutes outside the realms of universities, one in every region: east, west, south and north. Through their academic and research activities the institutes were invited to contribute to the advancement of technical knowledge in the country and promote advanced studies and research in various technical fields. The creation of such institutes marked the beginning of a new trend in engineering education.

The Indian Institute of Technology, Bombay, was set up in 1958, the second in the chain, the first being the Indian Institute of Technology, Kharagpur—established in 1951. The third and the fourth Institutes were started at Madras and Kanpur in 1959 and 1960 respectively. The fifth establishment of the same type came into existence with the reform of the College of Engineering and Technology, Houz Khas, New Delhi, which had been converted into the Technological Institute.

4. Establishment of the I.I.T., Bombay

The Indian Institute of Technology, Bombay, was established by the Government of India, as an expression of its faith in a new concept of higher technical education. The engineering science approach right from the undergraduate level leads the students to the understanding of fundamental principles which lay the foundation of all branches of engineering. Education at Master's degree level is a homogeneous blending of instructional course work, laboratory work, design and research, guided by faculty members, emphasis being laid on creative thinking. The education at Doctor's Degree level fosters creative thinking and research, where necessary, guided by faculty members, emphasis being laid on such research which makes a definite contribution to the advancement of knowledge. And just such foremost understanding of the problem is to a certain extent a desert of UNESCO Experts that had once been stationed at the I.I.T., Bombay

5. Guests of Honour

The foundation stone of the Institute at Powai was laid by the late Prime Minister Jawaharlal Nehru on March 10, 1959, and the Institute was shifted to its new compound from its temporary premises at Worli the same year.

A score of distinguished visitors favoured the Institute with their attention. Among them were the prominent statesmen, scholars and scientists. In December 1961, the first Convocation of the newly established Institute was attended by H. E. Dr. Radhakrishnan, President of the Republic of India, H.E. L.I. Brezhnev, Chairman of the Presidium of the Supreme Soviet of the U.S.S.R. and Dr. Malcolm S. Adiseishiah, Assistant Director General of UNESCO. In 1965, H. E. Rene Maheu, Director General of UNESCO also visited the I.I.T., Bombay, and unveiled a plaque commemorating the UNESCO assistance.

6. Admission figures

Originally the Institute was designed for annual admission of 320 undergraduate students for the courses of 4-year duration and 240 post-graduate students for the course of 1½-year duration. The total number of student population at the Institute at any time is planned to be 2,000. Later on, in connection with the revised plan, *e.g.*, 3 years for B.Sc. passed students, 3 years for I.Sc. passed students and 5 years for Higher Secondary passed students and of the P. G. students from 1½ to 2 years, the admission figures had been modified.

There are at present 1,688 students on the rolls of the Institute doing their undergraduate courses. More than 430 are preparing for their post-graduate and research courses, including 135 who are preparing for their doctorate degrees in engineering and science

7. Links with industry

In the years of phenomenal growth the Institute has maintained close links with industry through the short term refresher courses on specific particulars of industrial problems, invitation of prominent engineers for delivering of some lecture courses and employing of industrial workers to act as

L. to R.: Department of Electrical Engineering, Metallurgical Engineering Department, Lecture Hall and part of the Central Administrative Building

L. *to R.*: Computer Centre, Workshop Bays, Department of Mechanical Engineering and the Department of Civil Engineering

General view of the campus

Examiners for Home papers of undergraduate students and various dissertations submitted by postgraduate (M.Tech.) students. In their turn the staff-members of the Institute act as industrial consultants, thus strengthening relations between research laboratories and production shops in the interests of the nation's benefit.

8. The role of Indo-Soviet collaboration in the formation of the Institute

Side by side with the above described assistance through UNESCO, the Union of Soviet Socialist Republics has been rendering considerable assistance to the I.I.T., Bombay, in its formation and expanding through a number of bilateral Indo-Soviet agreements on scientific and cultural collaboration.

The first bilateral agreement on direct scientific links between the I.I.T., Bombay, and Soviet Higher Technical Educational Establishments was signed by the Governments of India and the U.S.S.R. on December 12, 1958. In compliance with this Act, the Soviet Union expressed its consent to provide the Institute 3 million roubles for acquiring Soviet equipment and recruiting U.S.S.R. experts and technicians.

Later on, with broadening and extension of Indo-Soviet scientific collaboration, the participation of the Soviet Union in the formation and expansion of the Institute became more and more extensive.

9. Accomplishments

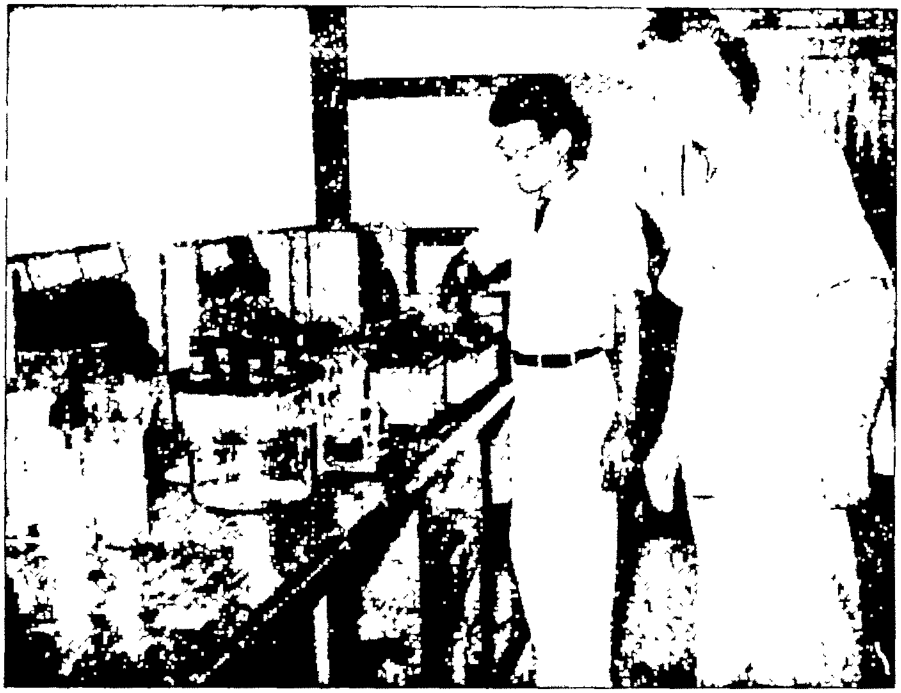
However, now that the UNESCO is nearing completion of its Technical Aid Programme Project No. 12 entitled 'Indian Institute of Technology, Bombay,' it is expedient to make an attempt to evaluate some of the accomplishments from the standpoint of experience gained through the realization of the project for the benefit of national higher technical educational establishments and advancement of technical knowledge in the country.

During the period stretching over 10 years tremendous work on compilation and working out of the project construction of the I.I.T. Campus, starting of academic courses and development of research activities has been completed in elbow to elbow collaboration between the Indian Government and the UNESCO on one side and the U.S.S.R. Government and Indian authorities on the other side.

UNESCO's participation and assistance to the I.I.T., Bombay, comprised several mutually integrating fields. Delivery of equipment, assigning of experts, fellowships for training abroad, innumerous consultations on various technical matters denominate only the major fields of UNESCO's assistance. Excellent facilities for delivering of academic courses and conducting of laboratory experiments have been provided to this Institute enabling its staff to produce well trained engineers for the needs of national industry.

10. Most essential feature

There is however one more essential feature about the Institute—that is, the number of young radiant faces that you see everywhere you go—in the autitoriums, lecture-halls, and even among the Lecturers and Professors that are on the staff. This gives one confidence in their strength and desire to undertake creative assignments wherever and whenever these are offered



Experiment on strain testing of structures is being conducted by a post-graduate student

Abundant volume of technical literature is within easy reach of students and staff of the Institute and makes any onlooker sure that their enthusiasm and willingness in combination with experience of their senior mates will help the Institute to stride along the path of progress.

11. Conclusion

As a result of combined efforts and day to day cooperation among UNESCO, the Government of India and the Government of the U.S.S.R., a first rate up-to-date technological institute of national importance sprang into existence and soon turned into an educational establishment equal in its standards to similar institutions in most industrially advanced countries. Hence, it appears that the target once marked as the Project No. 12 under UNESCO T.A. Programme entitled 'Indian Institute of Technology, Bombay' is now successfully accomplished and the whole project will be completed by the end of 1966. The appropriate column ceremony dedicated to the completion of the project is expected to take place on December 4, 1966, during the session of a seminar on 'Technical Education', sponsored by the UNESCO. This occasion will also serve as a powerful illustration for the delegates of the seminar on the actual fruitful accomplishments of the UNESCO in the field of higher technical education in this country and in the whole world.

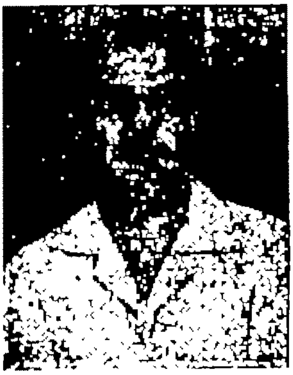
ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Nagpur Centre

Chairman's address by Shri Y. A. Khare, B.E., M.I.E., at the Annual General Meeting of the Centre on January 8, 1966

After welcoming the Chief Guest, and other invitees. Shri Khare thanked the Committee of the Centre for electing him the Chairman for the ensuing year.

Delivering the Chairman's address, Shri Khare said, 'I have decided to address you, on Self-Reliance in Industry, and the Role of Engineers'.



The aggression is an eye opener

The Pakistan: aggression has very vividly brought out the fact that the fact that the new situation calls for an intensified drive towards self-reliance in industry. We have fully realized the un-predictable nature of foreign assistance and support from the major world powers. We are determined to be self-sufficient. But this spirit of self-reliance must be harnessed properly. before we are again called upon for a test

Pakistan's certificate to our achievements

While a great deal still remains to be achieved, the new situation calls only for an intensification and quickening of trends, which are already being developed, rather than any sort of breaking away from such trends.

'You cannot stop supplies to us India has 80% of its defence requirements manufactured indigenously—while ours is hardly 20%.' This bitter and horrified scream of the Pakistani leaders, is the best recognition we have received for our planning.

Befitting achievements so far

Ours is a large country with abundant productive resources Barring a few things like non-ferrous metals, sulphur, phosphorus and a few others, we possess resources for practically everything else, which a modern industrial community needs. Labour may not be skilled, but it is available in plenty.

Our main effort during the three plans has been towards increasing the production of wealth. Today we are able to cope up adequately with the growing demand of steel. We are producing one-third of our crude oil requirement. We now make the bulk of sugar plant machinery, cement machinery, textile machinery, the normal range of machine tools, Diesel locomotives, wagons and coaches, automobiles, bicycles, fans, sewing machines and number of other things

Even consumer goods like sugar, cement, paper, rubber goods, drugs, pharmaceuticals, cellulose fibres, fertilizers, etc., are produced, if not in large quantities, at least to satisfy our essential demands

Our present industrial sectors

All the above-mentioned industrial growth was made through three sectors. The most important and dominant large scale industrial sector is exclusively controlled by the Central Government. The small scale industries sector which has come to prominence during the last 10-12 years is mainly controlled and looked after by the State Governments. The village industries sector, aiming at the revival and reconstruction of our handicrafts and age old arts and industries, is looked after. partly by the States and partly by a central autonomous body.

Diffidence about indigenous talent

An important drawback is noticed during all these years of our planned development. Not only entrepreneurs from private sector, but even the Government is hesitant to entrust to our engineers and technologists.

It was quite in order, that in the initial stages, we never wanted any failure in our major industrial programmes and were, therefore, after foreign technicians. The turn out of indigenous engineers and technologists was very limited during the first two plans. The envisaged technical institutes were either not established, or, were grappling with the problems of teaching But now the circumstances have changed, and we have enough output of technicians for utilization.

In no other country, except in India, we will find the design of the proposed Howrah Bridge being given to the same foreign firm, which designed the present Howrah-Bridge 25 years back. Is it that during these 25 years, we were not able to produce a single designer to handle the proposed bridge ?

There is one inherent drawback in our technical education. Except medical colleges, the acquired knowledge of our technicians, is not put to even preliminary tests during studies. The industrialization being in the preliminary state, the environmental influence on the society is still lacking. This has the effect of both the society and industry not recognizing the intrinsic value of indigenous technological knowledge.

Foreign consultants work as selling agents

Foreign consultants, whom we have to engage when we need their know-how, often impose conditions whereby there is a compulsion on the entrepreneurs to use only foreign machinery, irrespective of a few good indigenous machines being available in the country. Thus in addition to their very heavy royalties and fees, the consultants act as selling agents for their country's manufacture. Where only a few imported components would have sufficed, we have to order the full range of machinery, though many machines could be indigenously substituted. Thus, our foreign exchange load increases.

If Indian engineers and consultants are given the opportunity of designing such projects, definitely there will be an impetus to local manufacture and a saving in the foreign exchange component of the project

We must match this opportunity

If the nation concedes to technicians' request, the Institution may be able to locate a few of its corporate members, working as planners in high public offices, as directors of corporations and companies, as professors in institutes of higher learning and engineering universities, as consulting engineers and in other engineering organizations.

Unbalanced production of technicians

We want craftsmen and trained supervisors who can look after the work executed by craftsmen. The present polytechnics are hardly able to cater 50% of our demand. It will be better to lay more stress on polytechnics rather than on engineering colleges.

In our country, boys do not grow in the same type of technical environment as that in highly developed countries. Therefore, it is necessary to slightly alter our objectives to be achieved, during post-graduate studies. The objective to be achieved is to increase the depth in thinking, instead of gathering a wide range of information, mostly in fundamentals in a variety of subjects. This training of the mind of the students can be achieved, both through working out critically, design and development projects, and by working intensively on an investigation problem in a very narrow field of speciality. At present, the country needs design and development engineers, small scale industrialists, management engineers, and consultants in large numbers. If the engineering graduates are given practical training of two or three years, before admitting them to post-graduate courses, it will be more useful.

The role of small scale industries sector

Another undesirable feature of our industrial growth is its overconcentration in a few metropolitan centres, leaving out innumerable small and large townships, and of course, the entire countryside. The desired geographical decentralization of industries and their dispersal to nook and corner of areas having industrial potential, is an immediate necessity.

It is worthwhile noting that the growth of small manufacturing enterprises is among the most significant features of India's recent development. Wide opportunities for personal initiative and advancement have been demonstrated by such entrepreneurs.

This prosperity of small industries sector may not last long. The sheltered Indian market and restrictions on imports due to foreign exchange crisis are indirectly responsible for the sporadic growth of this sector. The manufactured articles are far below standard quality, and are very costly. If we want to earn more foreign exchange, by exporting goods manufactured by these units then these inefficiently run factories will need a thorough overhauling.

Best opportunity for engineers in small industries field

To assist these small units, the Central and State Governments have established many technical assistance and development organizations. Unfortunately there has been, and continues to be, great difficulty in securing and retaining adequate number of suitably qualified personnel, particularly those with practical industrial experience. Serious deficiencies in performances, have resulted from lack of technicians in certain fields and from inability of many technicians. Too much emphasis has, therefore, been placed on promotion of new units, without being able to give them the necessary technical assistance.

Shri S. G. Barve, our former Industries Minister, had thought out a very good plan. He wanted to establish 'forums' of industrial technicians in important cities in Maharashtra. Engineers working in important positions of different major and small industries were to get together to exchange their views and establish better contacts amongst themselves.

This forum of industrial technicians (F.I.T.) was expected to solve the difficulties of very small units, which otherwise, could not afford the services of such experienced technicians.

In our country, where experienced technicians are in short supply and where the inherent resistance of small industries, not to use the services of technicians, is to be removed, it is necessary that such forums are established. It will be worthwhile for the different local centres of the Institution, to seriously consider this sort of service.

All of us are aware that Indian small industrialists very seldom have drawing offices of their own. Manufacturing is carried out under conditions that would be called primitive in more developed countries. Preparation of design and drawings for machines and machine parts, equipments, dies, jigs, tools and fixtures can only be introduced by qualified engineers. The importance of economical use of raw materials, improved designs of machinery, demonstrations of modern technical processes, can only be appreciated by a technician. Business management, marketing, financial and cost accounting, production management, etc., are factors which ultimately decide economical cost of production and improved quality of the products manufactured.

Once these F.I.T. organizations get into swing, they can take up the publication of bulletins, pamphlets, model schemes, and other promotional literature. Industry, thus assisted by local technicians can impart dynamism to the economy of our country. With such a step, industrial development will not only mobilise the manpower and natural resources of the country, but also evoke a widespread efflorescence of enterprises, and add to the benefit and happiness of the community.'

Summaries of Papers Published in the Journal, vol. 47, no. 2, pts. EL 1, CH 1 and PH 1, October 1966

ELECTRICAL ENGINEERING DIVISION

621.316 : 621-52

1. **Auto-Reclosing on Transmission and Distribution Networks. S. C. Kapoor**, *Associate Member*

Auto-reclosing on primary distribution feeders and high voltage interconnectors renders improved continuity of power supply and higher transient stability limit. The operating cycle of the recloser and its coordination with fuses are discussed for application to rural distributon network and stability problems on interconnections on the basis of equal-area criterion are analyzed Further, the present practice in regard to single-phase and three-phase reclosing is discussed.

621.3-52.001

2. **Extending Routh's Criterion to Check the Relative Stability of Linear Systems. T. R. Natesan**, *Non-member*

In this paper an attempt is made to correlate three of the well known important stability criteria in control systems engineering, namely, Routh's, Nyquist's, and Mikhailov's. It is shown that Routh's criterion can be extended to judge the relative stability of a certain class of control systems. A new factor known as 'stability factor' is defined and it is compared with the gain margin of the system. There is complete agreement between these two and therefore, it is concluded that the test function in the Routh's array can be used to decide the relative stability of the system.

621.315 : 621.3.015

3. **A new Approach for Very High Voltage Transmission. S. A. Quader**, *Member*

Consumption of electrical energy in the country is rising at a phenomenal rate, so much so that production has been falling behind demand. There has been power shortage in practically every corner of the country with the result that even essential industrial production has suffered considerably. Exploitation of the economical sources of water-power more often than not requires long distance transmission. Longer the distance of transmission and larger the quantum of power to be transmitted, higher becomes the voltage for economic transmission. An attempt has been made in the paper to bring out the salient features of 700 kV transmission on the half-wave principles.

621.311 (548)

4. **Development of Power in South India. B. G. Rudrappa**, *Non-member*

South India is endowed with large potential for production of electricity both from hydro sources and large coal and lignite deposits. Industrial growth in this region in the post-independence period has been rapid and the demand for electric power so great that shortage of power has been experienced quite often. At present four separate systems, one in each of the southern states are operating independently and each has its own developmental programme. It is suggested that integrated operation and co-ordinated development of the four systems, it will be possible to achieve greater economy and produce energy at lower cost. The pattern of power development to meet additional load demands taking into consideration the characteristic of the load, load growth and seasonal nature of some of the existing stations, has been discussed in the paper.

621.313.13: 669.18

5. **Determination and Verification of Capacities of Main Drive Motors of Hot Reversing Steel Mills. B. P. Sarker,** *Associate Member*

Due to increasing demands of rolled steel products engineers are frequently required to verify the capacities of main drive motors of rolling mills or to determine the capacities of motors for new mills. This paper briefly reviews the methods of checking/determining the capacities of the hot reversing mill motors theoretically as well as from oscillograms of actual current loading

551.594 8

6. **Analytical Models in Lightning Phenomenon. Prof. B. Seethapathirao,** *Member,* **M. S. Raju,** *Non-member,* **and M. V. Chalama Reddy,** *Non-member*

The voltage developed across the insulator string during the lightning stroke which is responsible for line outages, is the special object of study. The methods developed by other investigations to derive the voltage across insulator string are very laborious. Analytical models are very helpful in obtaining the tower top potential. The curve for the voltage across the top insulator string of OVEC 345-kV tower obtained in this paper and the curved obtained by Wagner and Hileman are compared. There is close similarity between the two curves. The maximum potential across the insulator string obtained from analytical model almost coincides with the value obtained from field theory method.

621.362

7. **Compensating Networks for Adjustable Speed Drive on A.C. Systems. A. Subba Rao,** *Non-member*

The paper presented here deals with the operation of a shunt motor on A.C lines with a compensating network. Three compensating networks have been suggested one of which has been made use of and the test results show that there is a considerable improvement in the performance of the machine and a flat speed-torque characteristic can be obtained.

621.319.4

8. **Selection of Capacitors for Rectifier Devices. Prof. B. M. Tareev,** *Non-member* **and M. M. Lerner,** *Non-member*

For a correct choice of the best types of electrical capacitors to be utilized in rectifier circuits, one has to know well both the kinds and properties of capacitors now in manufacture and the regimes of operation of capacitors in these circuits. So far neither the specialists in the field of electrical circuits nor the specialists in electrical capacitors have duly examined the problem of the most expedient choice of capacitors for rectifier devices and also for some other electrical devices. In this paper, the authors have attempted to do the first step in the solution of the above-mentioned problem. It gives the formulae relating the characteristics of capacitors to regimes of their operation for rectifier devices of Graetz and Greinachar, the generalized characteristics determining the cost of capacitors, and the ways to choose the regimes of operation most economical from the view point of cost.

CHEMICAL ENGINEERING DIVISION

661.53 (541.5)

1. Coke Oven Gas Feedstock for the Manufacture of Ammonia with Special Reference to the Proposed Talcher Industrial Complex Project. D. Panigrahi, *Non-member* and Dr. H. P. Misra, *Non-member*

This paper discusses the various methods now in use for the production of ammonia synthesis gas from various liquids and gaseous hydrocarbons. The recent trends in the field of ammonia manufacture, e.g., employment of low temperature CO-conversion catalyst, use of centrifugal compressors for synthesis gas compression, its limitations, etc. have been discussed briefly. The importance of coke oven gas as a feedstock for ammonia production and process routes which can be employed to produce ammonia and urea is emphasized with special reference to the project envisaged at Talcher. In the present Indian situation, when fertilizer is an essential commodity for augmenting the food production, the importance of the use of the indigenous feedstock coke oven gas wherever available economically (specially from integrated iron works, as in the case of Talcher industrial complex) has been reviewed in detail.

621.357.8

2. Studies on Breakdown Voltage of Anodized Aluminium Surfaces. M. S. Raju, *Non-member* and G. J. V. Jagannadha Raju, *Non-member*

This paper presents the experiments conducted to study the breakdown voltage of the oxide films produced on vibrating aluminium surfaces. The experimental variables comprise of the bath voltage current and time of anodizing and the frequency of vibration. The measurements of the thickness and breakdown voltage of oxide films reveal that: (i) vibration materially reduces the unproductive power consumption by reducing the surface temperature local to the anode, and (ii) the effect of surface vibration is more pronounced at high bath voltages and at low frequency vibrations. It decreases with increasing frequency of vibration. The following equations are proposed to correlate the breakdown voltage and the thickness of oxide films with energy consumption for film formation on vibrating anodes.

553.96 : 662.813

3. South Arcot Lignite—a New Source of Energy in India. Dr. C. V. S. Ratnam, *Member*

In the context of search for new energy sources in our country, the place of South Arcot lignite, a new fuel now being used in the South Arcot District of Madras State, is discussed. The development of this project, especially the thermal station and the briquetting and carbonization plant, and the place of the products produced by these units in meeting the energy demands of various sectors in this region, are discussed in this paper

PUBLIC HEALTH ENGINEERING DIVISION

628.35.001

1. Optimum Incubation Temperature for the Primary Isolation of Coliform and Escherichia Coli Organisms. A. D. Bhide, *Non-member* and Dr. R. P. Mathur, *Non-member*

Faecal pollution of water is best determined by bacteriological tests. This paper indicates that, for day-to-day water analysis, the differentiation of Escherichia coli with the aid of enhanced incubation temperatures may be the plausible technique. Based on experiments with thirty pure cultures of the six common varieties of coliform organism at 30°C., 40°C. and 46°C., this paper concludes that the primary isolation of coliform organisms at temperatures over 45°C. tends to retard the growth of non-faecal types and permits, with restrictions, the growth of faecal types of organisms.

628.37

2. Dilution of Sewage for Irrigation. O. P. Bishnoi, *Member*

Domestic sewage can be profitably used for irrigation of land to increase food supply. From the point of view of manurial content, sewage can be diluted to give the same percentage of nutrients as would be obtained from the required dose of chemical fertilizer for a given crop. The dilution for different crops needs to be worked out. This paper discusses briefly the various problems involved in sewage utilization for agricultural purposes.

628.6 : 696.12.003

3. Some Aspects of Economy in Sanitary Plumbing—2: Junction of a House Sewer with the Municipal Sewer. R. C. Singh, *Associate Member*

This second part of the paper (*vide* Journal, vol. 46, no. 6, pt. PH 2, February 1966, p. 84) critically analyzes the feasibility of providing manholes at all junctions and at every point of change in alignment, gradient or in the diameter of sewer or drain, as stipulated in the bye-laws of most municipal authorities in India. Examining the problem from various view points, it concludes that the provision of manholes at all junctions of house sewers with the municipal sewer is wasteful and can be discarded with advantage. It also recommends that joinder junctions may be left while laying municipal sewers, although in sewers of less than 9 in. diameter these can also be inserted subsequently.

628.335(084)

4. Use of Nomographs for Quick Design of Sewage Treatment Plants. S. Subba Rao, *Associate Member*.

Several authors have published nomographs to facilitate quick design of of various units used in the treatment of water and sewage. Although designs can be made with the basic equations involved, the nomographs come in very handy for a busy design-engineer for whom, at times, the time factor becomes a primary consideration, particularly now and in future when a large number of water. upply and sanitation projects are going to be envisaged throughout India under the national and State water supply and sanitation programmes, engineers and sanitarians may find such graphs very useful. For purposes of convenience, these nomographs are classified under two main groups, *viz.*, sewage and water, and those useful for sewage treatment are compiled and presented in this paper with illustrative examples to show how these graphs are used.

623.3 : 539.16

5. A Study on Radioactivity of Rain Water. Dr. H. L. Uppal, *Member* **and Tarlok Singh,** *Non-member*

This paper presents a study of natural and artificial radioactivity of rain water samples collected at Amritsar during March-August, 1965. The beta-activity was estimated with high efficiency cylindrical type Geiger Mueller (G.M.) detector and identification of isotopes made with a gamma-ray spectrometer. The samples taken in July were more active than those collected in other months, which has been attributed partly to a delayed rainfall in that month and partly due to the Chinese atomic test in May, 1965. Radio-isotopes Pa 231, Th 227, Tl 207, and Ra 223 have been identified in the July samples. However, the amount of activity was within the maximum permissible concentration and thus, the atmosphere did not offer any health hazard

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INSTITUTION NOTICES

Recognition of passing Sections A and B of the Associate Membership Examination of the Institution

The Kerala Public Service Commission in a notification No. RIIC (13) 18633/64 dated December 12, 1965, inviting applications for the post of Lecturer in Telecommunication Engineering, announced that a 'Pass in Sections A & B of A.M.I.E. (India) will not be considered as sufficient qualification'.

The Secretary then took the matter with the Secretary of the Kerala Public Service Commission and the reply received from him is reproduced below for information of members.

KERALA PUBLIC SERVICE COMMISSION

THULASI HILL
PATTOM, TRIVANDRUM
Dated, 20. 9. 1966

No. RIIC (5) 25366/66/L.Dis.

From

The Secretary,
Kerala Public Service Commission
Trivandrum

To

The Secretary,
The Institution of Engineers (India)
8 Gokhale Road,
Calcutta 20

Sir,

Sub: Lecturer in Telecommunication Engineering—Sections A and B of A.M.I.E.—clarification—regarding

Ref: Your letter No. DKG/158 dated 2.9.1966

I am to inform you that the qualifications for the post of Lecturers in Engineering Colleges in the State including that of Lecturer in Telecommunication Engineering have since been revised by Government in G.O.M.S. No. 119/66/Edn. dated 8.3.1966.

The revised qualification is as follows:—

'Basic degree in the subject concerned or any other qualification recognised by Government as equivalent thereto with a minimum of 60% marks in the final examination qualifying for the degree.

Note: In the case of Ist or IInd Class post-graduate degree holders, the prescribed 60% marks in the concerned subject for the basic degree will not be insisted on.'

There is no clause in the revised qualifications disqualifying Sections A and B of A.M.I.E. (India).

Yours faithfully,
(*Sd.*) For Secretary
Public Service Commission

A copy of an office memodandum received from the Government of Uttar Pradesh in connection with the appointment of Assistant Engineer in the Town and Country Planning Department of Uttar Pradesh is also given below:

GOVERNMENT OF UTTAR PRADESH
NIWAS VIBHAG
No. 659-P/XXXVII-1 (19) (101)/66
DATED LUCKNOW NOVEMBER 17, 1966

OFFICE MEMORANDUM

The Governor is pleased to recognise a pass in Sections A and B of the A.M.I.E. (India) as a qualification for the purpose of direct recruitment to the post of Assistant Engineer in the Town and Country Planning Department of Uttar Pradesh Shasan.

S. M. MUSAFIQUE
SACHIV

No. 659-P (1)/XXXVII-1 (19) (101)/66

Copy forwarded for information and necessary action to:

1. Chief Engineer, Town and Country Planning Department, U.P., Lucknow
2. The Sachiv, Lok Sewa Ayog, U.P., Allahabad

3 The Secretary to the Government of India, Ministry of Scientific Research and Cultural Affairs, New Delhi 2

4. The Assistant Educational Adviser (Technical), Government of India, Ministry of Scientific Research and Cultural Affairs, North Regional Office, 7/169, Swarupnagar, Kanpur

5 The Secretary, State Board of Technical Education and Training, U.P., Station Road, Lucknow

6. The President, The Institute of Engineers (India), Pearl Mansion, 36 Queen's Road, Bombay 1

7. The Nideshak, Soochna Vibhag, U.P., Lucknow, for favour of issuing a press note

8. The Chief Engineer, Local Self Government Engineering Department/ Public Works Department/Irrigation Department, U.P., Lucknow

9 Local Self Government (B), Public Works (B), Irrigation (A), Power (B), Technical Education, Transport (B) & Agriculture Engineering Departments of the Secretariat.

By order,
(*Sd.*) D. P. Arya
U.P. Sachiv

Draft Indian Standards

The following draft Indian Standards have been issued recently.

1. Draft Indian Standard Specification for Sand Cast Brass Screw Down Pile Taps and Stop Taps for Water Services (Revision of I.S.: 781-1959) —Doc: BDC 3(1024).

This standard lays down the requirement regarding material, dimensions, constructions, workmanship, furnish and testing of sand-cast brass screw-down pile taps and stop taps for water services.

Members may send their comments on this draft standard before January 15, 1967, to Shri B. B. Rau (*A.M.*), Deputy Assistant Director, General, Public Health Engineering, Central Public Health Engineering Organization, Wing 8, Patiala House Annexe, Tilak Marg, New Delhi 1, who is the Institution representative on the Sectional Committee dealing with this standard.

2. Draft Amendment No. 4 to I.S.: 806-1957 Code of Practice for use of Steel Tubes in General Building Construction—Doc: SM BDC 7(833).

Members may send their comments on this draft amendment before February 20, 1967, to Shri D. C. Sharma (*M.*), 4E Sector 9C, Chandigarh, Punjab, who is the Institution representative on the Sectional Committee dealing with this Standard.

3. Draft Indian Standard Specification for Equipment for Grit Removal—Doc: BDC 40 (998).

This specification covers the requirements for grit removal equipment used in sewage treatment plant.

Members may send their comments on this draft standard before February 15, 1967, to Shri R. S. Mehta (*M.*), Director, Central Public Health Engineering Research Institute, Wardha Road, Nagpur 3, who is the Institution representative on the sectional Committee dealing with this standard.

Copies of the draft Standards may be obtained from the office of Indian Standards Institution, 'Manak Bhavan', 9 Bahadur Shah Zafar Marg, New Delhi 1, or from its branch offices at Bombay Mutual Terrace, Sandhurst Bridge, Bombay 7; 5 Chowringhee Approach, Calcutta 13, 14/69 Civil Lines, Kanpur, or 54 General Patters Road, Madras 2.

INSTITUTION NEWS

President's Itinerary

On September 8, 1966, the President, Shri B. P. Kapadia, accompanied by Shri T. P. Marik (*M.*), Chairman, Bengal Centre, visited the Kharagpur Sub-Centre. On the occasion, the Sub-Centre organized a Seminar on Productivity' as a part of the National Programme for India Productivity Year, 1966. Shri Kapadia also addressed a meeting of a Corporate Member and Students. The Kharagpur Sub-Centre was 'At Home' to the President in honour of his visit followed by a cultural programme in the evening.

The President arrived at Baroda on the night of September 19, where he was received by Shri M. M. Desai, Chairman, and Dr. S. M. Sen, Honorary Secretary, of the Baroda Centre. On the 20th, he visited the E.M.E. School at Fatehganj, Baroda, and discussed problems of engineering interest with the Officers of the School. In the afternoon he met the members of the Committee of the Sub-Centre and addressed a meeting of Corporate Members and Students. In the evening he attended a dinner given by Dr. C. S. Patel, Vice-Chancellor of the M. S. University of Baroda, in his honour. The next morning he visited the Gujarat Refinery where he took keen interest in the design of the water supply scheme He attended a luncheon given by the Committee of the Sub-Centre in his honour. At a tea party in the evening he discussed the problems of members and students and assured them of all possible help. On the morning of September 22, he visited Alembi Chemicals Ltd., and Jyoti Ltd., and was pleased to see the automation plants erected at these works.

The President was in Calcutta again from September 27-October 1, 1966. From October 1-2, he attended a meeting of the Planning Commission on Economy and Construction in New Delhi. He left Delhi on October 6 for Chandigarh and proceeded to Jullundur where he addressed the Students Chapter at the College of Engineering.

On 8th October, he reached Delhi again to make arrangements for the visit of the President of India to Hyderabad in connection with the unveiling ceremony of the statue of Sri Mokshagundam Visvesvaraya. On October 21, he visited the Nagpur Centre and addressed a meeting of Corporate Members and Students. He also visited the Visvesvaraya Regional Engineering College at Nagpur. The President was in the Headquarters Office from October 23-26 and then he left for Delhi to join a deputation to meet the Administrative Reforms Commission there. He further discussed the arrangements to be made for the visit of the President of India to Hyderabad. He visited the Orissa Centre at Bhubaneswar on November 7, and addressed a meeting of Members and Students. He then proceeded to Hyderabad to attend the functions connected with the unveiling ceremony of the statue of Sir Mokshagundam Visvesvaraya on November 12, 1966. On November 22, he visited the Bhopal Sub-Centre and addressed the Students' Chapter there. The following day he was taken round to the various Departments of the Heavy Electricals Ltd. He also visited the Maulana Azad College of Technology on 24th and met the Corporate Members.

On December 3, he flew to Jaipur to attend the meetings of the Council, the Finance Committee, the Engineering Education and Research Committee, and the Convenors of the various Panels held during December 4-5, 1966. He stayed in Calcutta from December 8 to 13. On his way back to Bombay, he visited the Sub-Centres of the Institution at Durgapur, Dhanbad, Ranchi, Jamshedpur and Rourkela. and addressed meeting of the Members and Students in these places.

NAMES OF SUCCESSFUL CANDIDATES IN THE STUDENTSHIP AND ASSOCIATE MEMBERSHIP EXAMINATIONS HELD IN MAY 1966

The following candidates have been elected to have passed the Studentship and Associate Membership Examinations held in May 1966.

STUDENTSHIP EXAMINATION

Roll No.	Name of candidate	Roll No	Name of candidate
St. 51	V. Ramachandran	St. 346	S. K. Kapoor
St. 67	M. K. Jawahar	St. 357	V. N. Kathpalia
St. 77	M. G. Bhat	St. 365	J. S. Bhatia
St. 102	V. Dhandayuthapani	St. 369	R. K. Gopal
St. 122	K. T. Thomas	St. 379	D. L. Sachdeva
St. 167	R. K. K. Tanwani	St. 418	O. P. Wadhwa
St. 172	S. S. Thantry	St. 424	S. M. Lamba
St. 187	G. S. Kahlon	St. 429	R. P. Sehgal
St. 188	P. R. Chitale	St. 433	Ved Parkash Sharma
St. 208	S. R. Gogate	St. 454	K. L. Talwar
St. 215	G. P. Rajput	St. 465	S. P. Paneneja
St. 226	R. V. Damani	St. 483	A. W. Rajwade
St. 241	V. K. Joglekar	St. 484	Biswanath Das
St. 257	R. P. Sinha	St. 563	N. Rama Krishna
St. 258	S. K. Rastogi	St. 609	S. V. Gupta
St. 272	S. R. Venkataraman	St. 615	Srinivasan
St. 278	C. Sesha Sayee	St. 627	R. Ananda Rao
St. 297	Gorananda Bhowmik	St. 629	P. E. Tongaonkar
St. 301	G. D. Manna	St. 636	R. Singh
St. 341	Avtar Singh	St. 647	M. M. Alexander
		St. 648	B. Singh

STUDENTSHIP EXAMINATION—*contd*

Roll No.	Name of candidate	Roll No.	Name of candidate
St. 656	Jaswant Singh	St. 903	M. Lal Garg
St. 659	P. Parkash	St. 935	M. B. Malpani
St. 678	S. Harihara Subramanian	St. 960	Krishnamurti Sivakumar
St. 684	S. N. A. Sheriff	St. 968	P. P. Joseph
St. 689	V. Vasudevan	St. 974	V. Thanappan
St. 701	M. V. Phillipose	St. 983	E. E. Potty
St. 765	Muttineni Sreeramulu	St. 994	P. N. Rao
St. 817	J. N. Joshua	St. 1000	K. R. S. Babu
St. 842	S. B. Pande	St. 1008	S. Venkatanandam

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A

Roll No.	Name of candidate	Roll No	Name of candidate
49A	V. P. P. Nampoori	1161A	M. C. Bhardwaj
80A	Bal Krishan Goyal	1208A	R. Rajam
97A	Ishwar L. Jadwani	1213A	G. Singh
104A	R. C. Sharma	1362A	Inaganti Subbarao
113A	M. L. Bindra	1374A	R. Padmanabhan Pillai
114A	Rajendra Swarup Asthana	1385A	Rameshchandra Punjabi
170A	C. L. Khiani	1392A	Vishnu Bokil
208A	G. Singh	1393A	Madhav Krishnarao Wale
274A	T. D. Vijayaraghavan	1425A	S. B. Kale
291A	S. S. Kundakur	1451A	V. V. Kamat
293A	G. A. Meti	1471A	Arabinda Chattopadhaya
322A	P. G. Manohar	1474A	S. P. Shivaram
345A	P. A. R. Van Ross	1510A	M. Balasubramanian
347A	B. Muninagappa	1542A	Hridaya Narayan Singh
360A	M. C. Anand	1546A	Ganesh Yashavant Lotlikar
369A	S. Raju	1557A	E. R. Joshi
382A	K. Skaria	1567A	P. N. Rade
539A	P. S. R. Bhaskara Rao	1584A	U. Narayan Aithal
555A	B. S. Nagaraj	1604A	K. L. Guliani
572A	P. S. Ramamoorthy	1608A	Amar Nandlal Ahuja
628A	Hameed Iqual Ahmed	1654A	S. Sunder
678A	Anwar Pasha	1707A	Nirmal Singh Papneja
760A	M. Hanumantha Rao	1795A	Anil Shankarrao Pandit
775A	S. Ramanathan	1823A	A. K. Sethi
777A	N. Parthasarathy	1847A	K. R. Venkatachalam
784A	V. V. Subramanian	1877A	Jagdish Kumar Tandon
789A	U. Anantha Kini	1891A	Panchanan Ghosh
818A	S. K. Kishore	1966A	Paruthkat Nandkumar Nair
896A	Om Prakash Rathore	1989A	S. K. Kulkarni
900A	N. R. Choudhari	2016A	Tapan Kumar Biswas
959A	K. Singh	2034A	Rohimon Kiash
960A	Vikas Taranath Patil	2036A	Asok Nath Banerjee
985A	Sourindra Nath Chatterjee	2057A	Susanta K. Mukhopadhya
996A	Surendra Nath Singh	2067A	Sobhamoy Kar
999A	Arvind Kumar Prasad Sinha	2087A	Deba Prosad Mitra
1025A	S. C. Bhattacharyya	2123A	Biswadas Basu
1030A	K. R. Kumar	2126A	Rup Chand Nandi

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A—*contd.*

Roll No.	Name of candidate
2131A	N. L. Mandal
2135A	M. S. Murthy
2148A	Nimai Charan Basu
2150A	A. V. Viswanathan
2153A	B. Ray Chaudhuri
2159A	A. K. Bhattacharyya
2205A	Nim Chand Haldar
2244A	T. L. Mitra
2292A	R. N. Gupta
2377A	J. C. Shankhary
2383A	Barun Kumar Mazumdar
2403A	Tapas Kumar Roy
2420A	S. K. Banerjee
2428A	S. P. Chakrabarti
2443A	Sk. Md. Abdul Hamid
2477A	A. K. Mukhopadhyay
2484A	S. K. Das
2508A	Sunil Kumar Dutta
2542A	Salil Kumar Basu
2574A	R. K. Banerjee
2598A	Jugal Prasad Ganguly
2622A	Tushar Kanti Chakraborty
2632A	K. De
2641A	Devavrata Sikdar
2712A	A. C. Kothari
2721A	A. K. Banerjee
2725A	R. Agor
2743A	Amiya Kumar Bhattacharya
2744A	Vijai Kumar
2753A	Ashok Kumar Jain
2775A	S. N. Datta
2783A	K. Raghuveer
2789A	S. K. Roy Chowdhury
2836A	Bimal Das Chatterjee
2875A	Kanai Chand Majumdar
2908A	Ranendra Chandra Pal
2993A	Smt. Aparna Das
3078A	Dalip Singh
3101A	Balbir Singh Jaswal
3149A	Subhash Chander
3156A	V. K. Bhasin
3175A	H. L. Aggarwal
3182A	D. Nand
3196A	Suresh Kumar
3201A	G. S. Bhatia
3223A	Resham Singh Gulahti
3229A	D. P. Bagga
3253A	Uggar Sain Garg
3275A	Bharpur Singh
3329A	D. N. Lakanpal
3339A	Om Parkash Mittal
3344A	R. Kumar
3352A	Raj Kumar Batra
3399A	Hari Chand Saini
3424A	Bhola Nath
3487A	Utsabananda Sahoo
3491A	B. K. Sarangi
3504A	Bibekananda Mohanty
3512A	A. B. Pani Grahi
3576A	Prasanna Kumar Pati
3605A	F. Khan
3624A	Krishan Lal
3638A	Rajinder Kumar Kapoor
3662A	S. C. Mittal
3666A	R. K. Bhirani
3671A	Rajpal Motwani
3675A	Kailash Narain Gaur
3692A	H. M. Khetarpal
3697A	Krishan Kumar Gera
3698A	R. N. Aggarwal
3701A	Jai Bhagwan Sharma
3703A	Harpal Singh Sharma
3708A	S. K. Goel
3722A	S. S. Nanda
3723A	Pheru Singh Verma
3724A	A. S. Sodhi
3745A	P. Singh
3761A	Devinder Nath Gupta
3771A	Sham Lal
3777A	H. C. Garga
3797A	G. C. Nandwani
3804A	Sham Murari Lal
3821A	S. K. Saini
3829A	Mohan Lall Ahuja
3831A	A. K. Puri
3870A	Virender Anand
3872A	P. N. Misra
3893A	Agam Prakash Jagota
3894A	Suraj Kumar
3901A	Sarvesh Chandra Saxena
3910A	M. Singh
3915A	Ravi Kumar Sikri
3925A	Thakur Dass
3947A	Kamlesh Kumar
4014A	S. R. Badlani
4015A	Kanayo Raghani
4038A	Subhash Chander Arya
4041A	R. K. Celly
4045A	D. Singh Ubhey
4051A	Bal Mukand
4054A	Krishna Kumar Agarwal
4062A	Ram Lal

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A—*contd.*

Roll No.	Name of candidate
4066A	S. K. Gupta
4069A	R. Choudhary
4096A	B. Bhushan
4105A	K. N. Bansal
4151A	C. L. Kapal
4185A	S. C. Girotra
4192A	J. L. Arora
4194A	V. K. Jain
4218A	N. N. Aggarwal
4237A	Narindar Kumar Ahuja
4243A	Raj Kumar Varma
4257A	J. N. Goel
4275A	Prithvi Raj Chawla
4346A	Sher Singh
4380A	Kewal Krishan
4404A	Prem Prakash Garg
4405A	Ramesh Chander Joshi
4406A	Harnam Dass Narola
4443A	R. Chander
4452A	A. P. Bhatnagar
4461A	Pavan Kumar Ghosh
4486A	Prem Chand Gogia
4487A	Yash Pal Singh Sharma
4493A	Mohindra Paul Katoria
4507A	D. D. Gulhati
4525A	Sewa Singh
4567A	O. P. Bhatnagar
4586A	R. J. Singh
4594A	V. K. Jain
4626A	Netar Krishan Nanda
4683A	Biswanath Bhattacharya
4696A	H. S. Phull
4747A	Jai Ram Sharma
4803A	Madan Kumar Satija
4853A	V. K. Kamboj
4856A	R. K. Gupta
4958A	Raghbir Singh Rajput
4964A	D. P. Goyal
4973A	B. D B. Goyal
5021A	Radha Nath Mukherjee
5042A	Ramprasad Bhattacharyya
5072A	T. S. Gill
5073A	Anup Kumar Bandyopadhyay
5102A	Ramesh Ganesh Page
5138A	N. Sarkar
5140A	Samir Datta Gupta
5179A	U. Ghosh Dastidar
5182A	Rames Chandra Karji
5184A	Debabrota Das
5202A	K. Kanhaiya
5260A	C. G. Saha
5317A	M. B. Goudar
5319A	L Thulasinga Mudaliar
5333A	Srinivasa Venkataramani
5345A	V. Ramadurai
5423A	K. G. K Murty
5439A	C. S. Pradhan
5445A	K. V. N. Reddy
5458A	Surendra Madhav Prasad
5478A	N. S. Venkata Subramanian
5505A	Merugu Mallesham
5506A	Vettiankal Varghese
5583A	M. C. Subbaramaraju
5603A	K V. Balamukund
5616A	B. S. Rao
5640A	I. Madhusudhan Reddy
5660A	S V. Narasinha Rao
5662A	V Radhakrishnamurty
5729A	K. Manikyala Rao
5762A	N. Harish Chandra Rao
5828A	T. S. Raghunathan
5882A	Rajeswar Pandey
5907A	M. R. Ghai
5920A	Mohanlal Motumal Madnani
5934A	J. K. A. Digikar
5945A	P C. Arora
5978A	P. D. Tamrakar
6053A	Sylvester Rodolfus
6059A	Benche Lal
6111A	S. C. Saxena
6162A	S. C. Bansal
6163A	M. C. Gupta
6172A	R. Singh
6174A	Kishan Lal Agarwal
6177A	N. Parsram
6179A	Dinesh Kumar Bhargava
6195A	G P. Gupta
6202A	Mangal Sain Saigal
6224A	Madan Lal Rao
6254A	P. C. Khatoria
6314A	Prem Nath Gupta
6315A	N. Singh
6324A	Kailash Chand Sanghi
6356A	Rameshwar Prasad Mali
6361A	Mohan Lal
6408A	Ethilkandy Radhakrishnan
6505A	Uddaraju Krishnam Raju
6518A	Nemi Chand Jain
6540A	Ranjit Singh Riat
6544A	S. N. Garg

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A—*contd.*

Roll No.	Name of candidate	Roll No.	Name of candidate
6579A	B. L. Suthar	7868A	R. K. Ghadai
6601A	Ashok Kumar Srivasta	7883A	Rama Chandra Mishra
6641A	Prem Pal Singh Malhi	7884A	Suryamani Das
6691A	Harmahendar Singh	7885A	Prafulla Kumar Mohanty
6723A	B. P. Das	7903A	K. S. Rao
6765A	Man Singh Chhikara	7914A	N. Sahu
6778A	P. C. Saxena	7924A	V. O. Mathew
6825A	K. K. Khare	7925A	Bushan Lal Wangnue
6827A	D. R. Singh	7926A	S. Vishnu Bhat
6850A	Radhey Shyam Trivedi	7927A	R. S. Rao
6865A	Godhan Singh Jina	7932A	Naweed Ahmed
6893A	Kuldip Singh Sethi	7945A	Aswatha Narayana Sadhu
6915A	D. C. Beri	7966A	Ananta Prasad Mohanty
6936A	H. K. Gupta	7987A	Chandra Sekhara Mishra
6956A	Kailash Narain Purohit	7989A	L. Purushothama Sarma
6957A	S. Jayaraman	7994A	C. M. George
6968A	B. K. Gupta	8012A	S. Nagarajan
6974A	Rajendra Kumar Agarwal	8039A	K. Narendran
6981A	M. M. Mathur	8067A	Mendu Rama Rao
7008A	Parmeshwari Prasad	8068A	R. Krishna Moorthy
7009A	Keshava Chandra Seth	8104A	G. R. Ranganathan
7028A	Gopal Swarup Kapoor	8126A	J. Lakshminarayana
7041A	Raja Bahadur Singh	8159A	R. Muthusamy
7063A	Sutish Kumar Chadha	8201A	R. S. Kanthan
7076A	Puran Shah Luthra	8206A	Venkatasamy Gurusamy
7083A	Udai Bhan Singh	8267A	P. S. Barve
7086A	R. P. Srivastava	8269A	K. G. Rao
7100A	V. P. Sinha	8271A	S. D. Armal
7114A	T. S. Pawaia	8274A	P. S. Jawadekar
7313A	S. C. Malhotra	8290A	Bhaurao Bhomaji Dudhe
7323A	A. Singh	8323A	Charan Kumar Relan
7336A	N. N. Chauhan	8358A	A. W. Deshpande
7440A	Daya Shanker Rai	8375A	Onkar Shivaramsa Bihade
7475A	Sushil Kumar	8408A	Padmanabhan Natarajan
7588A	Lov Niranjan	8415A	V. Parthasarathy
7606A	Mangal Singh	8468A	S. Venkataraman
7632A	N. S. Sohal	8495A	Kuppuswami Rajagopalan
7709A	Amar Chand Goyal	8537A	R. Muthumarayan
7738A	Pritam Singh Gill	8539A	G. N. Subramanian
7799A	Dontidi Bhupal Reddy	8548A	K. Venkatagiri
7821A	S. Sridharan	8593A	Brij Mohan Ahluwalia
7823A	M. Ramu	8613A	Piara Singh Punjab
7830A	P. S. Subramanian	8626A	Rameshwar Dass Sharma
7832A	Raju J. M. Kavalam	8633A	Satwant Singh
7844A	Niranjan Rout	8656A	Gurmukh Singh Nagi
7849A	K. N. Ramachandran	8678A	Ishwar Chander Sharma
7854A	V. V. V. S. Narauana Murthy	8682A	Girdhari Lal Naula
7856A	Gopabandhu Mishra	8714A	Sat Pal
7862A	N. Padhi	8743A	Nirmal Singh
7863A	Baratam Mohan Rao	8766A	Madan Lal Wadhwa
7864A	P. Gauda	8789A	M. S. Dhillon

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A—*contd*

Roll No.	Name of candidate
8790A	Surinder Mohan Gupta
8886A	Kulanand Thakur
8906A	Kailash Prasad
8945A	Arun Madhusudan Kanetkar
8952A	P. N. Kotasthane
9012A	Daya Ram Vishwakarma
9088A	G. Amin Peer
9119A	K. R. Laxminarayan
9163A	C. C. Thomas
9205A	T. V. Raghunatha
9267A	Sri Krishn Chopra
9273A	Ram Krishna Mahapatra
9276A	Suchayan Das Gupta
9277A	K. M. Lal Srivastava
9323A	Sheo Pratap Tewari
9326A	Raghuvir Singh
9361A	S. R. Singal
9372A	Suresh Chand Gupta
9397A	Keshar Singh
9406A	M. C. Tyagi
9418A	A. Singh
9430A	Om Prakash
9434A	Brij Mohan Chaukiyal
9436A	M. C. Maheshwari
9478A	Y. R. Malhotra
9506A	Sushil Kumar Jain
9513A	B. Singh
9583A	Dharam Vir
9604A	R. K. Sahu
9607A	G. C. Patra
9619A	Basudev Mahakul
9640A	A. Das
9641A	Narayan Chandra Pal
9669A	Anthony Savoio Athayde
9748A	Ramanand Mishra Raman
9797A	Veerindar Kumar Patwari
9798A	U. N. Kaul
9831A	Gopalan Sampath Kumar
9833A	K. Hydross Kutty
9842A	G. B. Kammath
9850A	P. G. Ramaswamy
9873A	P. Ramachandran
9880A	M. N. R. Nair
9902A	S. Parameswara Warriar
9904A	A. M. Gopinathan Nair
9946A	M. I. Paul
10020A	M. Gangaraju
10021A	S. Nagabhushanam
10049A	V. V. N. Murty
10069A	R. Mohanty
10071A	Kondaveti Kodanda Ramayya
10081A	Durga Charan Baral
10116A	Y. R. Rao
10126A	S. Ramarao

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B

Roll No.	Name of candidate
	Civil Engineering
20B	D. Jahiruddin Ahmed
40B	J. Pal
44B	A. R. Narasimha Iyengar
57B	B. V. Hegde
102B	V. G. Kashirasagar
118B	B. S. M. Nayak
122B	G. Singh
127B	Gulab Singh Arora
145B	C. D. Amdekar
157B	T. B. Rao
212B	B. Bhattacharya
231B	D. G. Chattoraj
248B	A. S. Mukherjee
249B	Saroj Kumar Gangopadhyay
253B	Shyamal Kumar Sen Gupta
255B	Prafulla Kumar Seth
268B	Sadhan Moy Guha
269B	Krishna Pada Roy
282B	B. Rudra
287B	Mihir Ranjan Das
291B	S. N. Sanyal
294B	Anil Kumar Ghosh
340B	Jagir Singh
351B	Hrusikesh Pany
362B	A. Patnaik
364B	R. Mohanty
365B	D. Samal
372B	Bijoya Kumar Mohapatra
376B	K. Swayin
377B	Malladi Balagopal
378B	D. Garanaik
387B	Ramachandra Mishra
390B	Shesadev Mishra
397B	A. C. Parida
401B	K. B. Mohanta
404B	D. Mahapatra

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B—*contd.*

Roll No.	Name of candidate
421B	R. Doraiswami
436B	B S. Sekhon
449B	Sundarlal Gupta
450B	D. S. Bhatia
453B	Santokh Singh Gill
516B	Shri Chand Gupta
517B	Ram Saran
520B	J. N. Arora
528B	L R. Sardana
532B	V. D. Jogiani
534B	Banarsi Dass Sangal
539B	D. S. Bhatia
540B	S. Ram
551B	Ashok Kumar Agarwal
585B	P. Dayal
590B	C. Bhatia
612B	Ram Parkash
618B	Bhagat Ram Goel
628B	Rattan Lal Bhat
638B	S. C. Jain
641B	K. M. Saxena
643B	N. K. Gupta
649B	Ram Nath
651B	V Kumar
694B	Satyesh Chandra Banerjee
704B	M. P. Krishnan
727B	Mohan Venkatesh Belagali
754B	K. S. Murty
801B	Vanam Viswanatham
816B	Sabbarapu Jogarao
847B	Kailash Chandra Puri
852B	R. K. Bhatia
853B	Madan Lal Sharma
877B	B. Singh
892B	G. K. Shadangi
911B	S. S. Gahlot
919B	Anand Thawani
935B	T. T. Isaac
954B	O. P. Kumar
979B	V K. Shandelya
983B	R K. Agarwal
986B	Y. S. Rao
1006B	Tirath Dass Taneja
1009B	A. Prabhakar
1010B	Rajdeo Singh
1015B	Shriram Gupta
1080B	M. Pitchandia Pillai
1090B	S. Raghavachari
1102B	C. S. Natarajan
1108B	Shri K. Tripathi
1109B	S. Ramanathan
1110B	K. C. Ramachandra
1115B	Subramaniam Sethuraman
1118B	I. K. Sundaram
1121B	K. A. Palaniswami
1127B	C. Shanmughperumal
1138B	S. N. Mangal Murti
1159B	V. Govindan
1163B	P. Srinivasan
1164B	M. Sivasubramanian
1184B	Saudagar Singh Grewal
1201B	Chander Parkash
1209B	Kamala Kant Singh
1226B	Harendra Prasad Tiwary
1240B	Ram Krishna Dubey
1244B	Raj Kumar Soni
1256B	S. M. Deo
1291B	Harishchandra D. Rao
1300B	Vasant Ganesh Achawal
1314B	U. C. Mahanty
1332B	Babua Jha
1344B	Chander Singh Sharma
1345B	V. Kumar
1382B	Subodh Kumar Nayak
1385B	Ramanathan Venkataraman
1388B	B. L. Kaul
1411B	Jacob Nainan
1412B	P. N. G. Nair
1427B	V. Idicula
1431B	M. A. Anthony
1432B	R. Gopinathan Pillai
1457B	V. V. Lakshmi Narasimham
1465B	Nandana Kumaraswamy

Mechanical Engineering

Roll No.	Name of candidate
11B	V. P. Singh
20B	Mallaiah
27B	E V. Sanyasi Kamaraju
29B	Manalath Narayanan Manala
39B	H. R. Krishna
53B	M. Kuppuswamy
56B	T. R. Venkatesan
58B	Srinivasarao Venkataraman
66B	J S. Jaggi
68B	K. V. Sampath
79B	Ramnathaiyer Prabhakaran
81B	S. Balakrishnan
84B	P. Kesava Ram
98B	V. C. Paramashivaiah
119B	R. Deo
128B	V. Raghavan
131B	Dinesh Chander Dhawan

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B—*contd*

Roll No.	Name of candidate	Roll No.	Name of candidate
134B	Gopal Krishan Gulati	677B	M. D. Ahuja
144B	S. K. Vijh	679B	J. P. Mehrotra
159B	Kedar Vinayakrao Gokhale	688B	M. S. Panesar
193B	M. Hussain	689B	S. C. Malhotra
194B	Mulakh Raj Khetrapal	700B	A. B. Chowdhury
204B	P. A. Prabhu	701B	B. Vaidhyanathan
205B	A. B. Dani	709B	T. V. S. Rao
207B	Ajit Kumar Bhattacharya	713B	D. K. Mukherjee
208B	Saradindu Chatterjee	715B	R. Devanathan
209B	M. G. Setty	724B	Subhas Chandra Sharma
224B	M. D. Punjabi	730B	H. Rahman
230B	V. N. Narayanan	732B	R. S. Khalsa
244B	B. G. Marathe	742B	S. N. Maini
246B	Asok Kumar Mitra	744B	V. M. Ojha
255B	D. S. Mayer	749B	Subhash Chandra Saxena
275B	A. K. Ray	769B	S. N. Misra
276B	S. Chatterjee	774B	Hari Om Prasad Srivastav
291B	Paresh Chandra Roy	775B	Subhash Chandra Khan
294B	V. Viswanathan	780B	R. K. Gupta
321B	Sunil Chandra Pal	782B	Balasubramanya Vishwanath
323B	Subodh Krishna Pandit	787B	Gulab Rai
324B	D. Ghoshal	792B	B. Dass
329B	Sisir Kumar Ghosh	796B	Virendra Prakash Rastogi
330B	Badri Narayan Ghosh	799B	N. S. Grewal
374B	S. Sen	803B	Raj Kumar Dhawan
400B	S. Mukherjee	806B	B. S. Natharu
412B	Asish Chattopadhyay	810B	Hardip Singh
448B	Kashmir Singh	812B	S. Balakrishnan
449B	Gouranga Sinha	821B	N. Ramachandran
451B	Y. R. Mahajan	829B	Vedagiri Ramaswamy Chetty
459B	S. L. Singh	834B	Narayan Chandra Das
465B	B. S. Padam	837B	Rajagopalan Uppili
479B	Chander Swaroop Agarwal	840B	M. Musa
495B	R. K. Puri	841B	Krishnaswamy Sethuraman
501B	Ramji Sahai Srivastava	852B	Thamida Guravaiah
504B	S. K. Gauba	860B	P. V. Krishnamurty
506B	Inder Kumar Chhabra	861B	K. P. Ramanathan
507B	Subhash Chander	863B	K. N. Velayutham
508B	S. K. Chawla	867B	K. Venkateswaran
510B	S. C. Chitkara	878B	V. Subramanian
513B	S. K. Vasisht	882B	M. Chandramohan
531B	Vidya Bhushan Sharma	892B	J. Jacob
536B	Om Prakash Kakar	900B	R. Narayansingh Vyas
554B	G. C. Ghosh	904B	M. Venkataratnam
569B	A. V. Rangarajan	909B	R. R. Gulrajani
574B	C. Ramarao Janmane	913B	A. Krishna Shivaswamy
575B	Kaza Eswara Rao	928B	Joginder Singh
580B	V. N. Rao	931B	P. K. Sarwal
620B	Kodali Madhusudhana Rao	941B	Bhagwat Pandey
659B	K. G. Sri Raman	945B	B. Ray
661B	Satya Paul Kohli	969B	E. T. A. Nambiar

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B—*contd.*

Roll No.	Name of candidate
972B	A. K. Guha Thakurta
986B	R. K. Bajpai
989B	R. A. Yadav
995B	N. P. Vishwakarma
1006B	Khan Chand
1008B	J. Singh
1012B	P. S. Malhotra
1017B	Ranbir Singh Bajaj
1032B	B. P. Gupta
1036B	Elyas Gulamhusen Katib
1041B	K. P. R. Nair
1045B	D. G. Patnaik
1051B	A. J. Rao
1056B	K. R. Krishnamachari

Electrical Engineering

Roll No.	Name of candidate
11B	D. Nachiketa
14B	Venkataramaiyer Subbaraman
23B	N. S. Srinivasa Rao
26B	H. D. A. Rao
35B	V. S. Nagarajan
37B	Agaram Balajirao Prahlad
40B	K. R. Adinarayana
43B	D. P. Reddy
48B	A. Jayaraman
49B	B. V. Achyutha Rao
67B	K. A. Natarajan
84B	C. S. Raghupathy
87B	B. N. Seshadri
104B	Ramaswami Bhaskara
112B	K. S. Sreenivasamurthy
118B	G. N. Sharma
121B	P. P. D. Nair
125B	Satish Kumar Pruthi
128B	K. S. Murty
130B	Vadapalli Satyanarayana
138B	T. C. Gera
139B	S. L. Gogia
144B	Debadas Maitra
145B	L. V. Iyer
157B	Sunder Sham Kakkar
158B	G. B. Arora
168B	A. B. Shinde
184B	Umesh Chandra Pant
189B	Ramesh Chander Bhargava
216B	M. S. Allaudeen
219B	R. Srinivasan
238B	T. S. Viswanathan
253B	Malay Kanti Basu
257B	Shiv Nath Rai Garg

Roll No.	Name of candidate
260B	Niranjan Saha
266B	Niranjan Datta
278B	D. Guha Thakurta
319B	Raj Kumar Tandon
320B	R. P. S. Bajwa
331B	Shiv Kumar Kalra
337B	P. C. Das
338B	J. P. Saxena
346B	S. S. Sandhu
347B	S. C. Vohra
350B	R. K. Sharma
356B	T. S. Sharma
358B	Kamal Kishore Kapoor
368B	Vinod Kumar Anand
373B	Krishan Lall Chawla
374B	Alauddin Khan
402B	Ravinder Kumar Madan
403B	Harprit Singh Batra
413B	Cpl. K. Rangaswamy Gopalan
430B	S. P. Ahluwalia
444B	R. S. Baidwan
464B	M. R. Krishnaswamy
466B	N. Sridhara
473B	D. Satyanarayana Sarma
474B	Eyyunni Veera Raghavachar
479B	P. Narayana
484B	P. Venkata Nadha Reddy
487B	K. M. Rao
489B	Kone Venu Nadh
512B	Niharendu Mukherjee
517B	B. Singh
522B	H. Chandrasekhara Udupa
523B	Dharmadhar Arya
525B	R. Jayaraman
526B	D. Krishan
528B	Satish Kumar Sharma
543B	Uday Bhan Singh Bhadauria
559B	Anand Mohan Singh
564B	V. Krishnaraj
566B	Pritam Singh Binner
569B	M. Singh
574B	Resham Singh Jaswal
580B	Jagjit Singh
587B	L. Sahoo
590B	V. S. Krishnamurthy
606B	P. V. Narayanan
611B	S. P. Lakshminarasimhan
635B	A. R. Venkatakrishnan
644B	M. L. Garg.
654B	D. R. Goyal
655B	S. K. Singal

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B—*contd.*

Roll No.	Name of candidate
661B	Baldev Singh
674B	K. S. Kale
678B	V. Thukral
699B	Om Parkash Chaudhary
708B	K. Haridas
727B	B. K. Nair
728B	P. Divakaran Pillai
731B	L. Srinivasan
737B	K. V. L. Murthy

Chemical Engineering

Roll No.	Name of candidate
2B	C. R. Krishnan
5B	Satish Chandra Varshney
7B	Brij Lal
37B	M. R. Saha
38B	P. B. Chowdhury
39B	A. Ghosh

Metallurgical Engineering

Roll No.	Name of candidate
11B	K. R. Dutta
22B	Shakti Pada Datta
23B	T. K. Bhattacharyya
26B	Swapan Kumar Bandyopadhy
28B	Umashankar Ghose
29B	A. K. Banga
35B	N. Chandra
46B	A. S. Majumdar
52B	C. K. Dikshit
57B	V. S. Bhat

Electronics and Telecommunication Engineering

Roll No.	Name of candidate
8B	Mrinmoy Kanti Dasgupta
10B	Shashikant Ganapati Kamat
13B	Saiyed Maqsood Husain
20B	Devalapura Shadakshari
28B	Nachhattar Singh
44B	B. S. Sandhu
46B	V. Srinivasamurthy
51B	T. D. Jose

FORTHCOMING EVENTS

Annual Meeting of the Indian National Group of the International Association for Bridge and Structural Engineering, Nainital, September 1967

The next Annual Meeting of the Indian National Group of the International Association for Bridge and Structural Engineering will be held at Nainital in September 1967, concurrently with the 30th Session of the Indian Roads Congress. It has been decided that articles and reports of works on structures in addition to bridges should be included in the Annual Report of the Indian National Group and members desirous of contributing articles may do so before May 1967.

Further details can be obtained from the Technical Secretary, Indian National Group of the International Association for Bridge and Structural Engineering, Jamnagar House, Shahjahan Road, New Delhi 11.

Symposium on 'Lubrication and Wear in Living and Artificial Human Joints', London, April 7, 1967

A Symposium on Lubrication and Wear in Living and Artificial Human Joints', organized by the Lubrication and Wear Group of the Institution of Mechanical Engineers in association with the British Orthopaedic Association will be held in London, on April 7, 1967. Many mechanical devices are used in the treatment of disease. However, only recently has it been generally appreciated that those working in the medical and engineering fields are often concerned with similar problems. It is hoped that, in addition to the normal presentation of technical papers, an exhibition of models and devices used in the field, a selection of appropriate films and slides will be included in the programme and a session set apart for presentation of up-to-the-minute reports on current research projects.

Further details can be obtained from E. P. Davies, Head of Group Department, The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminister, London, S.W. 1.

Canadian Congress of Applied Mechanics, Quebec City, May 22-26, 1967

The Canadian Congress of Applied Mechanics will be held at Laval University, Quebec City, Quebec, from May 22-26, 1967, as part of Canada's Centennial Year activities. General lectures in the various disciplines of Applied Mechanics will be presented by outstanding invited lecturers from Canada and abroad during the Congress. Engineers and scientists are invited to submit papers in solid mechanics, fluid mechanics, thermodynamics, mathematics as applied to mechanics and on experimental methods. Interested authors should send abstracts of not more than 3 type-written pages to Prof. W. D. Baines, Department of Mechanical Engineering, University of Toronto, Toronto 5, Ontario, Canada.

Further details can be obtained from Prof. E. A. Eichelbrenner, Department de Genie Mecanique, Universite Laval, Quebec 10, P.Q.

Bursaries for Overseas Women Engineers

As announced on p. 33 of the *Bulletin* for November 1966, the Second Conference of Women Engineers and Scientists will be held at the Cambridge University from July 1-9, 1967. The Caroline Haslett Memorial Trust, London, is offering bursaries to assist women engineers from overseas to attend the Conference. The Trust has allocated £500 for the purpose and wishes to spread the financial assistance over as many applicants as possible. Applicants should be qualified in any field of engineering or should be following recognised engineering training.

Application forms can be obtained from The Caroline Haslett Memorial Trust, 25 Foubert's Place, London, W. 1.

The First All-Union Symposium on 'Statistical Problems in Engineering Cybernetics', Moscow, February 14-20, 1967

The Symposium on 'Statistical Problems in Engineering Cybernetics' will be held in Moscow from February 14-20, 1967. The technical programme comprises submission of papers on the following topics:

(i) Systems optimal in the statistical meaning
(ii) Nonlinear problems of statistical dynamics
(iii) Design of control system mathematical models by means of statistical methods

(iv) Statistical dynamics of adaptive systems

(v) Statistical theory of learning systems

(vi) Statistical methods of control

(vii) Statistical methods of reliability evaluation

(viii) Application of the statistical trial method for the simulation of control processes

(ix) Statistical problems of large systems (optimal distribution of resources, servicing of claims, etc.)

(x) Devices for statistical information processing.

Further details can be obtained from The Organizing Committee of the First All-Union Symposium on Statistical Problems in Engineering Cybernetics, Kalanchevskaja ul. 15a, Moscow B-53, U.S.S.R.

BOOK ACKNOWLEDGMENTS

1. **The Taj.** B. L. Dhama. *Council of Art & Culture,* Jaipür, Rs. 6.50, 46 pages.

In this book the historical background, art and architecture and a brief description of the various parts of the Taj Mahal are given.

2. **Development of Irrigation in India.** Published by the Central Board of Irrigation and Power, Government of India, 1965. 231 pages.

Published on the occasion of the Sixth Plenary Session of the International Commission on Irrigation and Drainage held in India, in January 1966, this book gives details of the subject from the earliest times.

3. **Administration and Finance of Irrigation Works in India.** W. D. Gulhati. Published by the Central Board of Irrigation and Power, Government of India, 1965. 104 pages.

Published on the occasion of the Sixth Plenary Session of the International Commission on Irrigation and Drainage held in India in January 1966, this book gives an account of the present day practice in the administration and financing of irrigation works in the country indicating briefly the history of the developments leading to these practices.

4. **Irrigation Research in India.** Published by the Central Board of Irrigation and Power, Government of India, 1965. 159 pages.

Published on the occasion of the Sixth Plenary Session of the International Commission on Irrigation and Drainage held in India in 1966, this book highlights the various aspects of hydraulic and allied research on river valley projects in the country.

4. **A Textbook of Road Engineering.** A. K. Basu and P. K. Bhattacharjee. *Orient Longmans,* 1966. Rs. 12.50, 248 pages.

This book covers the syllabus prescribed for diploma examinations on the subject by the various Boards of Technical Education in the country. The subject has been treated from a practical point of view in addition to the theoretical approach. Several illustrative sketches, I.R.C. tables and precise working tables from practising engineers are also given.

6. **A Textbook of Engineering and General Geology.** Prabin Singh. *Katson Publishing House*, Ludhiana, 2nd edition, 1966. Rs. 16.00, 481 pages.

This book covers the syllabus on the subject of engineering geology of the Indian universities. Questions set by different universities and professional bodies are also given.

7. **Theory of Machines—Vol. 1.** N. C. Pandya and C. S. Shah. *Charotar Book Stall*, Anand, 1966, Rs. 17.50. 606 pages.

In this book an attempt has been made to present basic ideas and principles in the study of mechanics of machines. The scope of the book is to cover the syllabii of the various Indian universities and technical institutions. It also caters the requirements of the students appearing for the examinations conducted by the Boards of Technical Education of the different states.

8. **Boundary Value Problems.** F. D. Gakhov. *Pergamon Press*, 1966. £ 5-5-0, 564 pages.

This translation of an enlarged Russian edition of the book covers such aspects as 'new types of integral equations soluble in closed form' and 'immense boundary value problems'. This book studies boundary value problems in the theory of analytic functions, and differential equations of elliptic type and their application to singular integral equations with Cauchy, Hilbert and other kernels. The exposition is confined to linear problems with one unknown function. Though intended for university undergraduates attending advanced courses and for post-graduate students, the book will be of use to all who are interested in the solution of problems of mathematical physics by methods of the theory of functions of a complex variable.

9. **Engineering Materials—Selection and Value Analysis.** H. J. Sharp (*ed.*) *Iliffe Books Ltd.*, 85s., 419 pages.

This book discusses the selection of materials for a wide variety of applications. An attempt has been made to cover the more important conventional materials and also the more interesting innovations. The introductory chapter stresses the importance of value analysis, and there follow detailed treatments of particular design aspects or groups of materials. As much factual information as possible has been given, often in the form of tables, and there are extensive lists of references at the end of the chapters. The work is useful to engineers, designers, metallurgists and experts in the newer disciplines of materials science and materials engineering. It should help to break down the barriers raised by specialization in these fields and, with its value analysis approach, it should assist in solving many future problems in the selection of materials.

10. **Canadian Prestressed Concrete Institute Handbook.** L. Cazaly and M. W. Huggins. Published by the Canadian Prestressed Concrete Institute, 1964, 501 pages.

In this handbook information has been presented in a form most suitable for use in professional design offices and where necessary it has been weighted in terms of its relative importance in the design of normal structures. Part 1 of the handbook gives a commentary on CSA A135-1962 Prestressed Concrete; Part 2 deals with prestressed concrete design; Part 3 deals with joint mechanics; and Part 4 gives specifications and plant standards.

11. **Mechnical Engineers' Reference Tables.** Z. Elzanoevoski. *Iliffe Books Ltd.*, 1966. 25s., 82 pages.

This book is a compilation of tables of sizes and other data in constant use by mechanical engineers. Metric equivalents are given for every measurement included and there is a thumb index to each section.

12. **Advances in Machine Tool Design and Research.** S. A. Tobias and F. Koenigsbengen (*ed.*) *Pergamon Press*, 1966. £12, 799 pages.

This volume comprises the proceedings of the Sixth International M.T.D.R. Conference held at the Manchester College of Science & Technology in September 1965. Papers presented at the Conference are given under the heads: (i) Stability of Machine Tools; (ii) Machine Tool Designs; (iii) Machine Tool Structures; (iv) Bearings; (v) Metrology; (vi) Design of Numerically Controlled Machine Tools; (vii) Numerical Control of Machine Tools; (viii) Control Devices; (ix) Metal Cutting Processes; (x) Vibration and the Grinding Process; (xi) Grinding; (xii) Machining and Work Holding; and (xiii) Forming.

13. **Theory of Oscillators.** A. A. Andronov, A. A. Vitt and S. E. Kheikin. *Pergamon Press*, 1966. £10, 815 pages.

This English edition is based upon an up-to-date revision of the authors' original theory which was translated into English some years ago. Much new material is presented and as a result it is a valuable reference on the subject of oscillations, non-linear differential equations, plane methods and stability theory. The book will be a useful reference work for graduates studying particularly oscillations in the field of electronics.

14. **Progress in Aeronautical Science—Vol. 7.** D. Küchemann (*ed.*). *Pergamon Press*, 1966. 90s., 220 pages.

This volume is devoted to one particular aeronautical science, fluid mechanics, and to one particular subject in fluid mechanics, vortex motions, and all the articles it contains are in some way the outcome of a recent symposium on this subject, organized by the International Union for Theoretical and Applied Mechanics and held at the University of Michigan, Ann Arbor, in 1964.

15. **Progress in Control Engineering—Vol. 3.** R. H. Macmillan, T. J. Higgnis and P. Naslin (*ed.*). *Iliffe Books Ltd.*, 1966. 80s., 239 pages.

In each article in the book, the authors have attempted to review the background to their subjects before examining the latest developments of the past few years. This will allow any reader to bring himself up to the frontiers of knowledge in the topics treated. The reviews included vary from the highly mathematical to the predominantly practical.

PUBLICATIONS RECEIVED

A copy of the 'Proceedings of the Symposium on the Study of Soil Properties in Calcutta Region' has been received from the Bengal Centre of the Institution. This Symposium organized by the Bengal Centre of the Institution and the Central Building Research Institute, Roorkee, was held in September 1964. Papers presented at the Symposium and the discussions that followed thereafter are given in this publication.

A copy of a paper entitled 'Fuel Problems at High Altitudes and Sub-Zero Temperatures' by A. D. Tuteja and K. S. Anand has been received from the Indian Institute of Petroleum, Dehra Dun. In this paper, presented at a Seminar on 'Problems of Internal Combustion Engines at High Altitudes' held in 1964, an analysis of the problems of gasoline and Diesel at high altitudes and sub-zero temperatures is made and remedies, which have to be adapted to the requirement of a particular engine, suggested.

A copy of a paper entitled 'Phenomenon of Power Loss at Altitudes: Some Possible Remedial Measures for Counteracting the Problem' by R. A. Rao and B. A. Chitnavis has been received from the Indian Institute of Petroleum, Dehra Dun. Presented at a Seminar on 'Problems of Internal Combustion Engines at High Altitudes, held in 1964, this paper reviews the effect of the ambient variable on the performance of the internal combustion engines from the power-loss aspect and discusses some possible remedial measures for counteracting the problem.

A copy each of the papers entitled (i) 'Surface Roughness Measurement' by V. Venkataraman; (ii) 'Scientific Research for the Development of Indigenous Know-How' by M. M. Suri ; and (iii) 'Prospects of Ultrasonic Testing of Welds in India' by S. W. N. Swamy have been received from the Central Mechanical Engineering Research Institute, Durgapur.

A copy of a paper entitled 'Rectification of Lacey's Theory' by B. M. Bharadwaj, Consulting Engineer, has been received from the author.

A copy of a publication entitled 'Help to the Practice of Overhead Lines' by R. C. Guha, West Bengal Electricity Board, Calcutta, has been received from the author. This publication contains information on overhead lines for the use of engineers and supervisory staff engaged in planning and construction of overhead lines.

A copy of a publication entitled 'All About Chambal Valley Development' has been received from the Central Water and Power Commission, Government of India, New Delhi. This publication brought out on the completion and commission of the Gandhisagar Dam and the Kota Barrage on the Chambal River deals with the development of the Chambal Valley.

A copy of a publication entitled 'All About Rihand' has been received from the Central Water and Power Commission, Government of India. This monograph describes the construction of the Rihand Dam in Uttar Pradesh.

A copy of a publication entitled 'All About Sharavati' has been received from the Ministry of Irrigation and Power, Government of India. This monograph describes the construction of the Sharavati hydro-electric project in Mysore State.

A copy of the 'Annual Report on the operations of the Calcutta Improvement Trust 1960-61 to 1963-64' has been received from the Chairman of the Trust. This report gives the constitution of the Board of Trustees in these years and the principal officers of the Board. Information for the period are arranged under the heads: (i) Administration; (ii) Finance; (iii) Land and Housing; (iv) Improvement Schemes, Rehousing Schemes and Alignments; and (v) Litigation.

A copy of a publication entitled 'Symposium on Utilization of Metallurgical Wastes' has been received from the National Metallurgical Laboratory, Jamshedpur. The Symposium was held at the National Metallurgical Laboratory in 1964 and several papers were presented. This publication contains the full text of the papers, an author index and a subject index.

A copy of the first issue of a periodical entitled 'Journal of Mechanisms', edited by Prof. F. R. E. Crossley has been received from Pergamon Press Ltd., Oxford, England. This new periodical is entended to be of some interest to both the theoretical researcher and practicing designer, contains advanced mathematical papers with descriptions of new designs. The scope of the Journal is dissemination of scientific theory and applied engineering knowledge of mechanisms including the kinematics, kinetostatic and dynamic analysis and synthesis of linkages and cams; gears, gearing, belt and chain drives, their manufacture operation and vibrations; hydraulic-chamber mechanisms and many other forms of mechanisms.

A copy of the first issue of a publication entitled 'Inorganic and Nuclear Chemistry Letters—a Supplement to the Journal of Inorganic and Nuclear Chemistry' has been received from the Pergamon Press, Oxford, England. For rapid dissemination of new discoveries it appears that this publication will provide a medium in the broad areas of inorganic and nuclear chemistry.

A set of fine publications entitled (ii) 'The Concrete Tube Test'; (ii) 'External Rendering'; (iii) 'The Design of Precast Concrete Paving'; (iv) 'Testing to Destruction of Full-Size Portal Frames' by J. B. Read; and (v) 'Tests on Reinforced Concrete Frames: Pinned Portal Frames' by W. B. Cranston has been received from the Cement and Concrete Association, London.

A copy of the December 1965 issue of 'Magazine of Concrete Research' has been received from the Cement and Concrete Association, London. This magazine priced at 5s. per copy per issue is published four times a year by the Association.

A copy of a publication entitled '1966 British Joint Computer Conference' has been received from The Institution of Electrical Engineers, London. This Conference, sponsored under the aegis of the United Kingdom Automation Council, the British Computer Society, the Association of Certified and Corporate Accountants, the British Institute of Management, the Institute of Chartered Accountants in England and Wales, the Institute of Cost and Works Accountants, the Institution of Electrical Engineers, the Institution of Electronic and Radio Engineers, was held in May 1966 and covered topics of common interest to a wide range of users and designers of computing systems. Papers presented at the Conference are given here.

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here.

M. T. Bengali

Shri Mohsin Tyebali Bengali, B.E. (Mech.), B.E. (Elec.), D.I.C., A.M.I.E., died on April 3, 1966, at the age of 44.

Born in Bombay in 1922, Shri Bengali had his general education from the University of Bombay. He passed the B.E. (Mech.) degree examination in 1944 and the B.E. (Elec.) in 1945 from the Poona Engineering College. He attended a post-graduate course in Hydro-Power Engineering at the Imperial College of Science and Technology and obtained his D.I.C. in 1948. During 1945-46 he was apprenticed at the Tata Power Co., Bombay. In 1949 he joined the L.D. College of Engineering as Lecturer in Electrical Engineering. From 1957 to 1963 he worked as Planning Engineer in the Development and Research Division of the Calico Mills, Ahmedabad. He then worked for a firm of consulting engineers for about a year and a half and then started his own firm of consultants, the 'Scheme Consultants'. He was associated with the firm till his death.

Shri Bengali joined the Institution as an Associate Member in 1962.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organisations employing engineers. It is hoped that employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column, a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P.O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

YOUNG MECHANICAL ENGINEER, 28, passed Sections A and B of A.M.I.E. (India) examination; having 4½ years experience in machine shop, maintenance and erection with ordnance factories and a private firm; seeks prospective change. (Office ref. 261)

STUDENT of the Institution of Engineers (India), age 26, passed Diploma in Civil Engineering in First Division from the University of Roorkee, and Section A of the A.M.I.E. (India) examination; having 7 years experience in maintenance and construction of all types of irrigation works wants suitable job in Governmen, semi-government or private concern. (Office ref. E.S. 260)

YOUNG ARMY OFFICER from the Corps of Engineers, age 29, Civil Engineering Graduate and Associate Member of the Institution of Engineers (India), has 3 years previous civil experience in the design of R.C.C. and construction of building work. Service in the Army 3 years. Held various responsible administrative and technical appointments in the operational areas as well as peace stations. Available now for any responsible position in any of the reputed private undertakings with foreign collaboration. Willing to work anywhere in India, South India preferred. (Office ref. E.S. 262)

Serving as Captain in the Indian Army, having 11½ years experience in the Air Force as ground technician in electrical trade, and 3½ years as a Commissioned Officer in the Army, passed Section A of the Institution of Engineers (India); seeks suitable employment. Minimum salary acceptable Rs. 500 per month. (Office ref. E.S. 263)

YOUNG ENGINEER, 34 years, throughout first class B.Sc., B.Sc. (Engg.), A.M.I.E., U.K. trained, having 12 years experience mostly in the manufacture of high voltage indoor and out door switch gears, control gears and control panels, fully conversant with current management and production techniques including material planning and controls; job evaluation, production planning and scheduling, data processing and cost controls, etc., presently working as head of the department in an European concern seeks challenging assignment in the middle management level. (Office ref. E.S. 264)

YOUNG MECHANICAL ENGINEER, age 25 years, possessing B.Sc. degree in Mathematics from the Kerala University and passed Sections A and B (both new schemes) of A.M.I.E. (India) examination with Automobile Engineering and Water Power Engineering as optional subjects; seeks a suitable job in Government undertakings or in private organization anywhere in India. (Office ref. E.S. 265)

QUALIFIED CIVIL/STRUCTURAL ENGINEER, age 32 years B.Sc. (Hons.), passed Sections A and B of A.M.I.E. (India), passed Graduateship and Section A of A.M.I. Struct.E. (London) having 10 years experience in drawing, estimating and designing of heavy steel and R.C.C. structures such as bridges, workshop buildings, water tanks, etc., holding responsible position in Central Government and possessing high sense of duty, seeks a suitable position in a leading industry. Also willing to be sponsored for advanced studies on long term service contract basis. (Office ref. E.S. 266)

Structural Analysis of Beams and Slabs

Dipl.-Ing J. Hahn translated by C. V. Amerongen **70s net**

The merits of this book, which was originally published in Germany, lie in its exceptional practical value and the simplicity and clarity with which the different problems are presented. In particular it contains a large number of useful tables and diagrams on most types of slab design, and many of the analytical methods are of very recent derivation. Throughout, the theory is clearly explained and there are forty tables of design data. Designers will find this book useful in dealing efficiently and quickly with many routine problems.

Industrial Management

P. King-Scott **27s 6d net**

This book has been written for those moving into industrial management and who recognize the need for further study. Specifically it is intended to assist candidates studying for examinations of the Institutes of (British) Mechanical Engineers, Production Engineers and Works Managers, and the new Certificate in Supervisory Studies. The author rejects many of the outdated theories of the early ergonomists, and writes with the practical management experience he has gained over the past twenty years.

Advanced Electrical Power and Machines

G. S. Brosan and J. T. Hayden **£5 net**

Based on the paper of the same name in the B.Sc.(Eng.) Part III examinations of London University, this book assumes only an elementary knowledge of magnetism, electrical machines and networks. From this it develops the theory in a way which emphasises the physical concepts involved. An important new text-book for Electrical Engineering Students.

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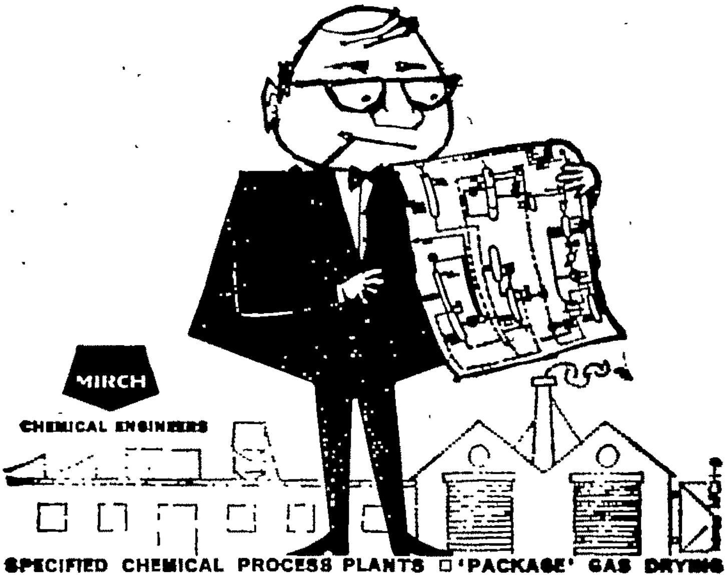

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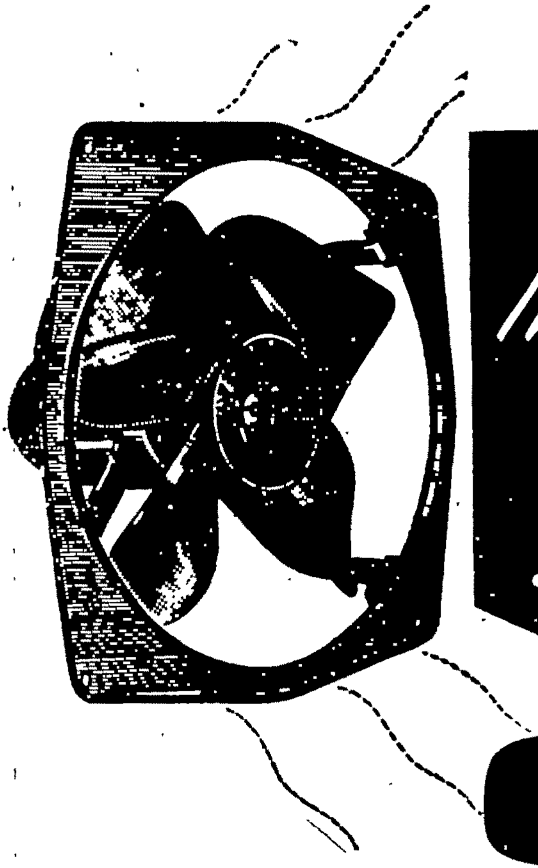

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PLEASE SEE PROGRAMME OF THE FORTY-SEVENTH ANNUAL GENERAL MEETING AT BOMBAY IN FEBRUARY 1967 ON PAGES (I) TO (xlviii). ALSO STUDENTS INTENDING TO APPEAR IN THE MAY 1967 ASSOCIATE MEMBERSHIP EXAMINATIONS PLEASE SEE NOTICE ON PAGES 41-42 AND APPLICATION FORMS AT THE END OF THE BULLETIN.

BULLETIN OF
THE INSTITUTION
OF
ENGINEERS (INDIA)

Vol. 16, No. 5, JANUARY 1967

Supplement to the Journal of the Institution of Engineers (India).
Vol. 47, No. 5, January 1967

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*Names repeated

BOMBAY WELCOMES YOU

TO

THE FORTY-SEVENTH ANNUAL CONVENTION

AT

The New Building of the Bombay Centre, Clerk Road,
Mahalakshmi, Bombay

No. AGM 47

The Institution of Engineers (India)

8 Gokhale Road, Calcutta 20

January 14, 1967

The Forty-Seventh Annual General Meeting of the Institution of [redacted] ngineers (India) will be held in the building of the Bombay Centre, Clerk ad, Mahalakshmi. Bombay, on Friday, February 24, 1967, at 3.30 p.m.

AGENDA

confirm the minutes of the Forty-Sixth Annual General Meeting (circulated in the January-February 1966 issue of the *lletin* of the Institution, pages 1—53).

ve the Annual Report of the Council and the Audited nts of the Institution for the year ended August 31, *ll follow*).

3. e report of the Council on the election for the 7-68 of (i) the President : and (ii) members of the

4. To a Auditors for the year 1966-67 and to fix their remuneration.

R. N. Banerjee
Secretary

TO ALL CORPORATE MEMBERS

Dear Sirs,

The Business Session of the Annual General Meeting is a very important meeting; it is the only meeting where the Corporate Members can have the opportunity of meeting the President, the Past-Presidents, Council Members and others. It is the only meeting where items of general importance, question of accounts, enrolment and examinations, questions about the administration and the management of the Institution by the President, the Secretary and the Staff and any other poi [redacted]
in connection with the administration of the Institution can be rai
by all the Corporate Members.

Up till now it has been only a very formal function lasting f
30 minutes for reading and passing of the report, approving of
ment of accounts and appointment of Auditors. It should
be expected that there should be no less attendance in
Session than that in the Inaugural function of the Annu

The President feels it necessary that a departure this
respect this year and hopes that the Members will usiness
Session of the Annual General Meeting in large n rticipate
actively in the discussions.

ithfully,

B. Kapadia

President

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

January 14, 1967

NOTICE OF MEETING OF CORPORATE MEMBERS UNDER BYE-LAW 82(b) (i)

NOTICE is hereby given that a Special General Meeting of Corporate Members of the Institution will be held at the building of the Bombay Centre of the Institution, Clerk Road, Mahalakshmi, Bombay, on Friday, February 24, 1967 at 3.00 p.m. for the following purpose:

To consider the proposed revision to the Regulation 64 of the Council which has been recommended by the Council to the Corporate Members of the Institution at its 45th Meeting held in Ootacamund on 29th [redacted] pril, 1966:

'Resolved that the recommendation of the Finance Committee be pted and the 'Year-Book' be published once in every three years, and, xt 'Year-Book' be published for 1967-68 with a suitable nomenclature lication'.

her resolved that Regulation 64 be accordingly amended, and that nd place for calling a Special General Meeting under Bye-Law r this purpose be left to the President'.

n 64 reads as below:

'64 Book shall be an annual publication and shall be published as s icable after the last day of August in each year.'

By order of the Council
R. N. Banerjee
Secretary

N.B.:—If yo to attend the Meeting personally, please fill up the accomp ng Form of Proxy with the name of some person whom you think fit to appoint as your Proxy. Please sign the Proxy Form on a revenue stamp of twenty P. and return the Form to the Secretary, The Institution of Engineers (India), 8 Gokhale Road, Calcutta 20, on or before February 20, 1967, in an envelope marked 'Form of Proxy' on top.

(Please turn over for 'Form of Proxy')

FORM OF PROXY

The Institution of Engineers (India)

I,..................................of...................................

being a Corporate Member of the above Institution hereby appoint............

....of...........................

or failing him.............................of ....

as my proxy at the Special General Meeting of the Institution to be held on 24th February, 1967, and at any poll held in connection therewith.

As witness my hand.......................day of................1967.

20 P.
Revenue
stamp

Signature..................................

Name in block letters...................

Class of membership in I.E.I................

FORTY-SEVENTH ANNUAL GENERAL MEETING
BOMBAY, FEBRUARY 24-28, 1967

Preparations are in full swing to celebrate the 47th Annual Convention of the Institution at the new building of the Bombay Centre, Clerk Road, Mahalakshmi, Bombay, during February 24-28, 1967. For the second time in a short interval, the Bombay Centre of the Institution will have the honour to act as hosts to the Convention, the last occasion being the 41st Annual Convention which was held in Bombay in 1961. The Bombay Centre extends to you a cordial welcome. In anticipation of the many delegates, who will come here during this period, the Organising Committee of the Centre has set out to contribute its efforts, not only to render the Convention an interesting and instructive technical get-together backed up by lively engineering excursions and historic tours, but also to ensure a comfortable sojourn to the delegates and guests pervaded by 'Get-acquainted' receptions and [redacted] ocial events conducive to good fellowship. A concurrent programme is o being planned for the ladies.

In order to ensure that this visit to Bombay is a pleasant experience, cipants are requested to complete and positively return the Acceptance given at the end of this programme, indicating their acceptance on re January 31, 1967, so that the required reservations are taken well in advance. A separate Acceptance Form is also given for f ladies accompanying the delegates.

events, to be held during the Convention, will provide a sup- ramme worthy of the occasion. Interesting Paper Meetings nged in the various Divisions and Groups. Other features i r Lectures, Talks and Panel discussions on technical su essional problems of topical interest.

adjunct to the Technical Programmes will be the inform rs to industrial plants and projects and visits and excursio elics of history and culture.

Me are that rail concession has been withdrawn by the Railway due to the National Emergency. However, as a result of the efforts made by the Headquarters to secure a resumption of the concession, the Railway Board has been pleased to extend, as a special case, rail concession to persons attending this Convention at Bombay on production of the requisite Certificate from the Secretary of the Institution. The conditions of the rail concession and the Certificate Form to be completed by the delegates are attached at the end of this programme.

THE ANNUAL GENERAL MEETING

Business Session

The Business Session of the 47th Annual General Meeting will be held at 3.30 p.m. on Friday, February 24, 1967, in the building of the Institution at Clerk Road, Mahalakshmi, Bombay-34.

Inaugural Session

The Inaugural Session of the 47th Annual General Meeting will commence at 10.30 a.m. on Saturday, February 25, 1967, in the building of the Institution at Clerk Road, Mahalakshmi, Bombay-34.

The Convention will line up several features :

- *Sir Mokshagundam Visvesvaraya Lecture*
- *Paper Meetings in the Divisions and Groups*
- *A Seminar*
- *Technical and General Sessions of the Student Members*
- *Nidhu Bhusan Memorial Lecture on 'Technology as a World Unifying Medium'* [redacted]
- *Local Visits and Outstation Tours to sites engineering interest and historic attra*
- *A Programme for Ladies—Fashion Shows— ing Exhibition—Conducted Shoppin*

THE TENTH SIR MOKSHAGUNDAM VISVESVARAY

'To honour the outstanding achievements of Sir Mok s-vesvaraya in the field of engineering, the Lecture will de ral subject allied to engineering and will be of interest to a This, the Tenth Sir Mokshagundam Visvesvaraya Lecture, w ed by Shri S. B. Joshi, a Past-President, between 3 p.m. an e Institution building at Clerk Road, Mahalakshmi, Bomba Saturday, February 25, 1967.

THE FIRST NIDHU BHUSAN MEMORIAL LECTURE

The Council has accepted the proposal of Dr. G. P. Chatterji (*M.*) to institute Memorial Lectures (*vide* Resolution 29 of the 446th Council Meeting, held in Bombay, on 6th August, 1966). The 'Nidhu Bhusan Memorial Lecture' (to commemorate the name of his departed father) is to be delivered on subjects related to Science, Philosophy and Spiritualism. Outstanding persons in the field of Science, Philosophy and Spiritualism will be invited every year to deliver this Lecture.

Prof N. S. Govinda Rao (*M.*) will deliver the Nidhu Bhusan Memorial Lecture on 'Technology as a World Unifying Medium' on Monday, February 27, 1967

PAPER MEETINGS OF DIVISIONS AND GROUPS

Typical of the programme, extensive technical sessions in the seven Divisions and ten Groups of engineering, falling within the purview of the Institution's functional activities, have been drawn up. These will include several Paper Meetings, in which the authors will present and report on papers of the year published in the *Journal* and provide, by discussion and mutual exchange of viewpoints among members, a summary appraisal of the problems, practices, trends and progress in these fields and their implications in the engineering profession.

Procedure for Paper Meetings

The Chairman of the Division/Group will open the proceedings with an address and outline the procedure for discussion on papers. For some Groups, where no papers have been published in the *Journal*, papers may be allowed and announced for discussion by the Chairman on the floor of the meetings scheduled for them in the Convention programme.
[redacted]formal gatherings may be arranged for those keen to discuss topics
ociated with the field of engineering catered for by these Groups. A
ly complete list of papers in the other Divisions and Groups is given
pages that follow.

thors and participating members are specially requested to bring
copies of the *Journal* containing the relevant papers in which
terested.

ost of the papers are published in the *Journal*, they are taken
the author of each paper (if present in person) or the mem-
by an author to present the paper on his behalf, is called
u ce the paper, limiting himself to the salient aspects of the
pa n declared open for discussion. In order to facilitate as
mu s possible and their subsequent handling for publication
in th se desirous of participating in them should submit in
writin they propose to make, preferably a day prior to or
at least ommencement of the Paper Meetings.

The ngs will conclude with a summary of the proceedings
by the Ch nd other announcements, if any.

Authors who wish to project illustrations for the purpose of introducing their papers should write to the Headquarters Office as to their requirements. Efforts are being made by the Bombay Centre to procure the necessary projectors, etc., for each Paper Meeting, if sufficient notice is given. Authors of papers needing financial assistance to go to Bombay to present their papers may contact the respective Divisional Chairman.

SEMINAR ON 'RURAL ELECTRIFICATION AND RURAL WATER SUPPLY'

The Seminar will be held on Sunday, February 26, 1967, between 11 a.m. and 1 p.m. The titles of papers and other contributions will be announced later, if available in time

In the context of the conditions of drought and near-famine condition existing in many parts of the country, no subject fitter than the one chosen for the Seminar could have been selected. The failure of monsoon has not only affected the supply of foodgrains for the rural population, but has denied many villages of the basic necessity of drinking water. The rural electrification and rural water supply therefore are but two sides of the same picture.

During the three Five-Year Plans the generation of power in the country has increased a number of times but the distribution of most of the power generated has been to industries and industrial processes. India which lives in villages has not so far got its rightful share of the electrical energy, production of which as stated above has increased manyfold.

Rural electrification is not only lighting electric lamps in the humble cottage of a villager but is making available to him power for other purposes and thereby releasing the labour disproportionately spent on th[redacted] activities which could have been done with the least amount of labo if electricity was available to him.

The lighting of an electric lamp in the humble cottage of a [redacted] peasant is a revolution in itself. It changes the outlook of the peasant staying in that cottage from one of mediaeval age to one trial age. It has been a common experience in the State of Mad has today reached the first rank in the rural electrification, th complex of a village is changed when electricity is made a The village housewife is no longer required to get up at the dawn to pound the rice or to grind the grain and then tak k to the nearest possible source of water, the village we th the advent of electrical energy to the village, the grind rice mill opens up and the daily chore of labour is el work which was done in hundreds of small huts by tiri early hours of morning for hours together is done in a her rice mill or flour mill in a matter of minutes and wi of human labour. The advent of electricity has made it po n electrical pump to be fitted by the *Panchayat* on the well and g the water within the easy reach of every hut, thereby reducing the long walk with the balanced pot on the head for collecting the day's water supply. The lighting of an electric lamp in a humble hut makes the inmates feel that they have been removed from the dark ages and have been brought nearer to the society as a whole. It is a pleasure to hear the small radio sets that pour out music from the hut in distant hamlet when the village folk not only hear to music, but also to the daily news of the happenings in the world and which, in addition to entertaining them, enlightens them.

The vast market that has opened for the ancillary engineering industries, such as cheap radio sets, fans and other electrical gadgets of use in the home is really a process which cannot be correctly estimated. If one can see the electrical shops springing up in the villages and small size towns in Maharashtra, where Koyna electricity has now been supplied. one really wonders the vastness of the market, which has been opened with this for ancillary electrical industries.

The question of rural water supply is also very closely related to the well-being of the population of the country. It was only a few years ago that in some of the parts of the Konkan District of Maharashtra that one could see at least one disabled person per family due to the affliction of the thread-worm. It was recognized that affliction came from the pollution of only and meagre source of supply of water to the village. Travelling down on the Bombay-Goa Road, one now finds the protected village water supply scheme with a closed water system and taps with clear paved surroundings and proper drainage arrangements and one also feels the difference in the reduction, for that matter complete elimination, of the cases of the afflictions of thread-worms. The protected water supply to the village not only meets the needs of the drinking water of the villagers but also goes a long way towards the betterment of the public health in [illegible]e rural area We all know that most of the tropical diseases, especial-[illegible] of the gastro-intestinal system are water-borne. We also knew that [illegible] polluted water supply sources which were meagre in the villages are [illegible]reatest sources of pollution and danger to the public health. The [illegible]e in the longevity of the Indian population will to a certain extent [illegible] upon the provision of protected water supply in the rural areas.

[illegible] the availability of electricity in every village of India, the daily [illegible] which human efforts are unnecessarily lost being saved, with [illegible]lity of electricity in every village of India to lift water from [illegible]pply and for watering the fields and the availability of pro-[illegible] supply to the population of villages, India can become a N[illegible]hy, contented people whose basic needs of food, water an[illegible]t are met. It will not be out of place to hope that the Sem[illegible] being held on this subject will bring forward valuable sugge[illegible]inions, which will help the planners to achieve in the foresee[illegible]he hope expressed above.

CONVENTION PROGRAMME

Friday, February 24, 1967

9.30 a.m. to 12.30 p.m. 2.00 p.m. to 6.30 p.m.	Registration of Local and Outstation Members
9.30 a.m. to 10.30 a.m.	Meetings of the Division Boards
10.30 a.m. to 11.30 a.m.	Meeting of the Chairmen of the Division Boards
11.30 a.m. to 12.15 p.m.	Finance Committee Meeting
12.15 p.m. to 12.45 p.m.	Meeting of the Indian National Committee for World Power Conference

12.45 p.m. to 1.15 p.m.	Honorary Secretaries' Meeting
1.15 p.m. to 2.30 p.m.	Recess
2.30 p.m. to 3.00 p.m.	Adjourned Meeting of the 1966-67 Council
3.00 p.m. to 3.30 p.m.	Special General Meeting
3.30 p.m. to 5.00 p.m.	Business Meeting of the 47th Annual General Meeting
5.00 p.m. to 6.00 p.m.	Panel Meetings
Saturday, February 25, 1967	
10.30 a.m. to 1.00 p.m.	Inauguration of the 47th Annual General Meeting
1.00 p.m. to 3.00 p.m.	Lunch (by Courtesy of Larsen & Toubro Ltd.)
3.00 p.m. to 4.00 p.m.	The Tenth Sir Mokshagundam Visve[illegible]varaya Lecture on 'Bridge Engineering [illegible] India' by Shri S. B. Joshi, Past-Presi[illegible]
4.00 p.m. to 5.30 p.m.	Technical Paper Meetings
5.30 p.m. to 6.30 p.m.	'At Home'
8.00 p.m. to 12.00 midnight	Variety Entertainment
Sunday, February 26, 1967	
9.30 a.m. to 11.00 a.m.	Annual Meeting and Session [illegible] Centre
11.00 a.m. to 1.00 p.m.	Seminar
11.00 a.m. to 12.00 Noon	Engineering Education [illegible]ch Committee Meeting
1.00 p.m. to 2.00 p.m.	Lunch (by Courtesy of [illegible]eering Co., Ltd.)
2.15 p.m. to 5.00 p.m.	Meeting of the 1967[illegible]
2.30 p.m. to 5.00 p.m.	*Technical } Sessio[illegible]udent Members
5.00 p.m. to 6.30 p.m.	General
8.30 p.m.	Annual Banquet
10.30 p.m. onwards	Variety Entertainment
Monday, February 27, 1967	
9.30 a.m. to 1.00 p.m.	Technical Paper Meetings
1.00 p.m. to 2.00 p.m.	Lunch (by Courtesy of Kamani Engineering Corporation, Ltd.)

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* Students desirous of presenting papers at this session should send their manuscripts to the Headquarters Office at Calcutta not later than February 10, 1967.

2.15 p.m. to 3.15 p.m.	Nidhu Bhusan Memorial Lecture on 'Technology as a World Unifying Medium' by Prof. N. S. Govinda Rao
3.15 p.m. to 6.00 p.m.	Technical Paper Meetings
8.30 p.m. to 12.00 midnight	Variety Entertainment
Tuesday, February 28, 1967	
9.00 a.m. to 12.30 p.m.	Local Visits
1.00 p.m. to 2.30 p.m.	Lunch (by Courtesy of Associated Cement Co., Ltd.)
2.30 p.m. to 4.30 p.m.	Popular Lecture on 'Conservation of Rain-water in Underground Reservoir before any Flow Begins to Move Down above Ground' by Shri S. R. Bhagwat Popular Lecture on (to be notified later)
4.30 p.m. to 5.30 p.m.	Closing Session of the 47th Annual General Meeting
Evening	Leave Bombay for Outstation Tours
[illegible]ay, March 3, 1967	Conclusion of Outstation Tours and Dispersal

OUTSTATION TOURS

[illegible]r Outstation Tours in Maharashtra and Gujarat are being organiz[illegible]ct to sufficient response from the delegates. Since it would be [illegible] to restrict the number of delegates that can be accommodated in [illegible] depending on the housing, transport and other conveniences, [illegible]stration is very necessary. The names of participants will be [illegible] on receipt of full payment of the charges fixed for each to[illegible] which are given below. Delegates are requested to inform the [illegible]ecretary, Bombay Centre, of their first choice (and also an[illegible]ice) of the tour in which they wish to participate, on or b[illegible] 1967. Registration for the tours will be filled in the order i[illegible]y are received. The delegates are advised to bring their own bed[illegible] warm clothing, etc., for the tour.

All these tours will commence on the evening of Tuesday, February 28, 1967 from the Bombay Central railway station for Tour No. 1 and the Bombay Victoria Terminus for Tour Nos. 2, 3 and 4 and will conclude on March 2 and 3, 1967.

SPECIAL INSTRUCTIONS

1. All the railway journeys will be by first class with sleeping berths. Arrangements are being made to reserve bogies which will be detained at the railway stations.

2. There will be a limited number of berths available and booking will be strictly according to the order in which the application forms are received.
3. Application forms along with the full amount by M.O./Cheque should be sent to the Honorary Secretary, Institution of Engineers (India), Bombay Centre, Ilaco House, Sir P. M. Road, Bombay 1, so as to reach him on or before January 31, 1967. Applications received after this date may not be accepted.
4. No cancellation will be permitted unless done before February 20, 1967. If not done in time the amount advanced with the application may not be refunded.
5. If there is not sufficient response for any of the tours by the closing date for receiving the applications, the delegates will be informed of the cancellation at the earliest.

LOCAL VISITS

Local visits are also being arranged for delegates during the Conventio[illegible] on Tuesday, February 28, 1967. The number of delegates that can par[illegible]cipate in each visit has to be necessarily limited for the purpose of facilita[illegible] inspection. The programme for local visits is as given in the table belo[illegible]

Tour No.	Project	Number of delegates	Tim[illegible]
1	Indian Institute of Technology, Powai	100	9.0[illegible]
2	Premier Automobiles Ltd., Kurla	100	[illegible]m.
	Larsen & Toubro Ltd., Powai	50	[illegible]0 a.m.
		50	[illegible] Noon
3	Crompton Greaves Ltd., Bhandup	50	[illegible].30 a.m.
		50	[illegible] 12 Noon
4	Atomic Energy Establishment, Trombay	150	9.00 to 12 Noon
	Esso Refinery	50	9.00 to 10.30 a.m.
		50	10.30 to 12 Noon
5	Tata Thermal Power Station	50	9.00 to 10.30 a.m.
		50	10.30 to 12 Noon

LADIES PROGRAMME

A separate programme for ladies accompanying members is being arranged and a Registration Fee of Rs. 15 will be collected from each delegate accompanied by a lady. This will enable them to attend all the functions arranged during the Convention, including the special visits that may be arranged for ladies but excluding the Annual Banquet, Outstation Tour and hotel charges.

Special visits, conducted shopping, Fashion Show, Catering Exhibition, etc., will be generally arranged for ladies accompanying the delegates The detailed programme will be as under. They may also join delegates for the local project tours.

POSTS & TELEGRAPH AND TELEPHONE FACILITIES

Arrangements are being made to open a temporary Posts & Telegraph Office during the Convention at the Institution. The P. & T. Depart[illegible]ent have agreed to receive telegrams and forward them for onward [illegible]nsmission through regular channels.

A special telephone call booth is being arranged for the convenience [illegible] visiting delegates.

GENERAL INFORMATION FOR PARTICIPANTS

[illegible] fee

[illegible]on of local members will start at 9.30 a.m. on February 23, [illegible]tion of outstation members and visitors attending the Co[illegible] commence at the Bombay Centre's building at Clerk Road, Ma[illegible]mbay 34, at 9.30 a.m. and continue upto 12.30 p.m. on F[illegible]y 24, 1967. For the convenience of the delegates and ac[illegible]ersons who may arrive later, the registration counters will be o[illegible] p.m. to 6.30 p.m. on Friday, February 24, 1967.

Deleg[illegible]o attend the Convention are requested to ensure in their own[illegible] the Acceptance Form complete in every respect and the necess[illegible]ances are received by the Bombay Centre latest by January 31, 1[illegible]. The registration fee is :

Corporate Members & Graduates	..	Rs. 20.00 per person
Lady Guests	...	Rs. 15.00 per guest
Students	...	Rs. 10.00 per student

Transport from railway station/airport to place of lodging and from place of lodging to meeting places, entertainment halls, conducted tours for the ladies, local visits will be provided to all delegates and their lady guests registered for the Convention.

Annual Banquet

The Annual Dinner will be held on Sunday, February 26, 1967, at 8.00 p.m. at the Institution Shamiana. The charges payable for attending the Annual Dinner are:

Corporate Members, Graduates and their Gentlemen Guests	Rs. 15.00 per person
Lady Guest	Rs. 10.00 per guest
Students	Rs. 10.00 per student

Arrangements for Return Journey

Reservations for return journeys of the delegates will be arranged, if the exact date of departure to their destinations is intimated sufficiently in advance. Local travel agents are in charge of these arrangements. A special information counter will be opened for this purpose.

GRANT OF CAUSAL LEAVE FOR GOVERNMENT OFFICERS ATTENDING MEETING OF SCIENTIFIC ASSOCIATIONS

An extract from Notification No. 74(4)/-50-SR.III dated July 29, 195 [redacted] printed in the *Bulletin*, Vol. 1, No. 1, September 1951, p. 28, and No. -(7)/53-SR.III dated December 10, 1953, printed in the *Bulletin*, No. 3, March 1964, p. 14, issued by the Ministry of Natural Scientific Research, Government of India, in regard to the grant leave to such officers as desire to attend meetings of scientific is reproduced below for information :

'. . . . . subject to the exigencies of Government [redacted] ernment servants who are invitees, members, official the organisation concerned or have been asked to read papers nce may be given facilities to attend meetings organised by ciations like The Indian Science Congress Association, stitute of Science of India, The Institution of Engineers Indian Academy of Sciences, Bangalore, and other similar grant to them of special casual leave to the extent ce at the meetings and for journeys to and from the It is requested that if there is no objection, requests from Government servants for leave to attend meetings of scientific ons may be disposed of in the light of this decision.'

DELEGATES ACCOMMODATION

Bombay has a few large and luxurious as well as small but convenient hotels, and other additional facilities, all within sufficiently close reach of the Convention grounds. A demand on accommodation for a gathering of our magnitude will be large and is generally limited in view of the constant inflow of foreign tourists. Provision is being made to accommodate the delegates in the hotels and hostels listed in the following pages. Their address, style, rates, telephone numbers, etc., are also furnished to assist the intending delegates in the selection and reservation of accommodation of their choice ahead, so as to avoid last minute disappointments.

Members are therefore particularly requested to remit the hotel charges as early as possible, but, at any rate, as to reach not later than January 31, 1967, to The Honorary Secretary, The Institution of Engineers (India) Bombay Centre, Ilaco House, Sir P. M. Road, Bombay-1, for the number of days for which accommodation is desired, specifying the name of the hotel or hostel. Accommodation will be necessarily alloted strictly in the order or priority of applications received and no accommodation can be assured on applications received late. It is advisable that members funish an alternative choice of accommodation, to ensure that in case their first choice is not available, it is possible to offer them alternative accommodation.

SIGHT-SEEING IN BOMBAY

You would surely like to know something of this great metropolitan city, the capital of Maharashtra State. For over a century, Bombay has been the nerve centre of India's trade, commerce and industry. It not only imports mercantile goods through its excellent harbour, but also has been over years of passage of social and scientific ideas and ideologies from the West, while essentially and proudly retaining its oriental characteristics. It has thus cradled many social and political movements, which were later to shape the course of India's destiny.

It is here that one finds perhaps more than anywhere else in India a perfect blending and fusion of the best of the cultures of the East and West.

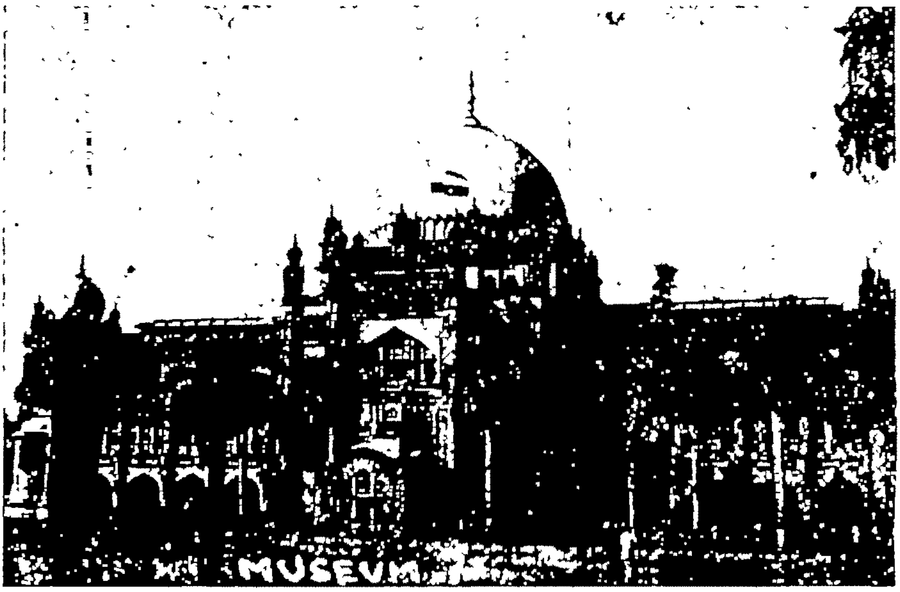
With its magnificent harbour, its imposing, multi-storeyed structures, fast rolling transport, crowded-to-capacity thoroughfares, every busy shopping centres and above all its wide sky-line blazing by night with colourful neon lights, Bombay has a grandeur and beauty all its own. Its waterfront on the Arabian Sea, the superb sweep of the Marine Drive, the Malabar Hill with its perennial greenery, the palmfringed beaches and gardens and a host of other beauty spots in and around the city, have a spell-binding and refreshing charm.

With its museums, art galleries and an array of theatres and cinema houses, Bombay caters to all interests and tastes however fastidious they may be. Nor is this the entire fare that it has to offer. There are numerous sights and vistas spread before you, as you move from place to place and locality to locality.

And now a brief introduction of some of the important places you would like to visit during your stay in Bombay:

Prince of Wales Museum

This is one of the main attractions of Bombay. Built in Indo-Saracenic style architecture, the Museum has an imposing dome modelled on the architectural styles of Western India of the 15th and 16th century. The Museum has Art, Natural History and Archaeological Sections and some smaller ones devoted to other specialized subjects. In the grounds of the Museum is the Jehangir Art Gallery where art and photographic shows by local as well as outside artists are held. In the square opposite to the Art Gallery is the equestrian statue of King Edward VII by Boehm, which is one of the finest pieces of sculpture in Bombay.



THE PRINCE OF WALES MUSEUM, BOMBAY

Gateway of India

To the east of the Museum within a walking distance is Bombay's wonderful harbour. Past the Council Hall where the State Legislature meets, you come out in a wide open space known as Apollo Bunder which is a towering structure very near to the sea, which is the Gateway of India. Erected to commemorate the landing of King George V and Queen Mary in 1911, the Gateway consists of a central hall with large archways and side halls. English architect Wittett designed the Gateway which is based on the 16th century Indian architecture. In the wide open space, facing the Gateway, stands the equestrian statue of Chhatrapati Shivaji, the founder of the Maratha Kingdom and India's national hero, as the guardian of her freedom and liberty.

THE GATEWAY OF INDIA VIEWED FROM A DISTANCE

Sachivalaya

On the Foreshore Road, past the Band Stand and statue of Babasaheb Ambedkar, the great champion of scheduled classes, is Sachivalaya, the seat of Maharashtra Government, commanding a grand view of the bay at the Nariman Point. This stately, imposing, multi-storeyed building combines in it many novel features of modern architecture and structural engineering. Built in 1955, it has since been added with an Annexe and a beautiful garden on its right besides the one on its precincts. On a turret, about 200 ft. above the ground, flutters India's national flag.

Brabourne Stadium

A few yards from the Churchgate Station, the terminus of the local train service of the Western Railway, stands the Brabourne Stadium, the biggest in Asia, with a capacity to accommodate about 40,000 spectators at a time. Important sport events and tournaments including Cricket Test Matches and ceremonial parades are held at this stadium, which is owned by and forms part of the Cricket Club of India.

Marine Drive

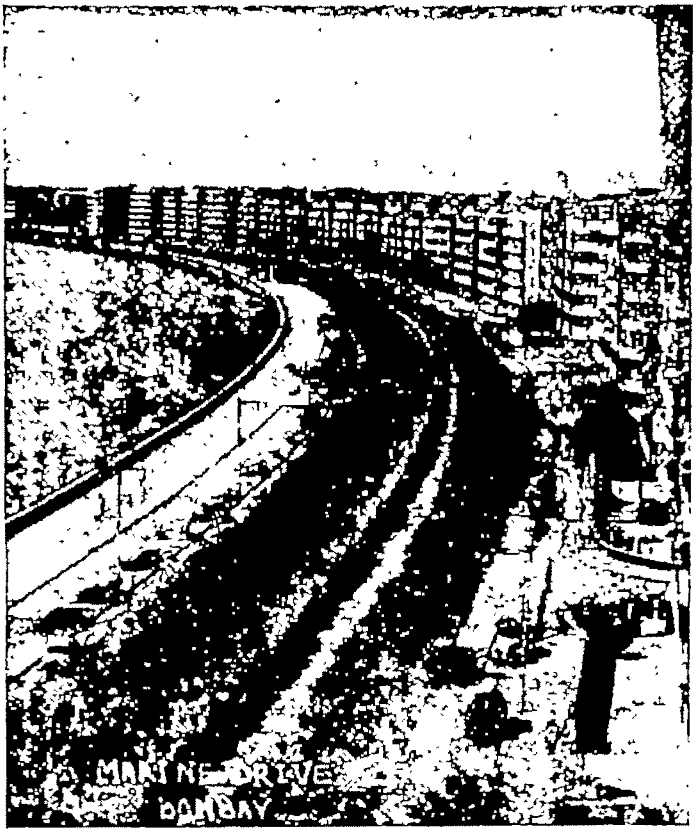
From Nariman Point to Chowpatty beach is Bombay's finest promenade by the sea—magnificent Marine Drive. It is difficult to believe that this long stretch of land was once a part of the sea. Its reclamation some four decades ago was a superb engineering feat. The row of stately buildings on one side, the two-way cement-concrete road with a box hedge all along in the middle and cars racing on it in an almost unbroken chain, the broad, long-winding walk with a massive parapet wall and the deep blue sea beyond—such is Marine Drive which is indeed Bombay's best show piece. In the evening, it wears all the more lovely look with thousands of gay strollers enjoying the cool sea breeze and the beauty of the sun-set on the sea. And the night transforms Marine Drive into a veritable dreamland with myriad lights shining all along the semi-circular arc and their reflections shimmering in the dark water. It is indeed an unforgetable sight which is best seen from the Malabar Hill.

Taraporevala Aquarium

The Taraporevala Aquarium, situated on the Marine Drive, the Necklace of Bombay, is one of the best in the East. Opened in 1951, it was built at a cost of Rs. 9,00,000 of which Rs. 2,00,000 was met from a donation by the late Mr. Vicaji D. B. Taraporevala. The line exhibits are displayed in the main hall with an outer circuit of 18 marine tanks and an inner circuit of 9 tanks. The capacity of each tank averages 1,000 gallons. There is, in addition, a Miniature Exhibits Section where tropical fishes from all over the world are displayed in natural settings. Shellcraft articles and fish by-products complete the display.

Mani Bhavan

Mani Bhavan had a long and intimate association with Mahatma Gandhi, for he occasionally lived here from 1917 to 1934. Now in Mani Bhavan, the Gandhi Smarak Nidhi conducts activities aimed at promoting studies in Gandhian thought and philosophy. A picture gallery gives glimpses of Gandhiji's life through photographic posters and photostats of some important documents written by him. There is also a library here which contains Gandhiji's own works and books by others on his life and thoughts in about half-dozen languages.

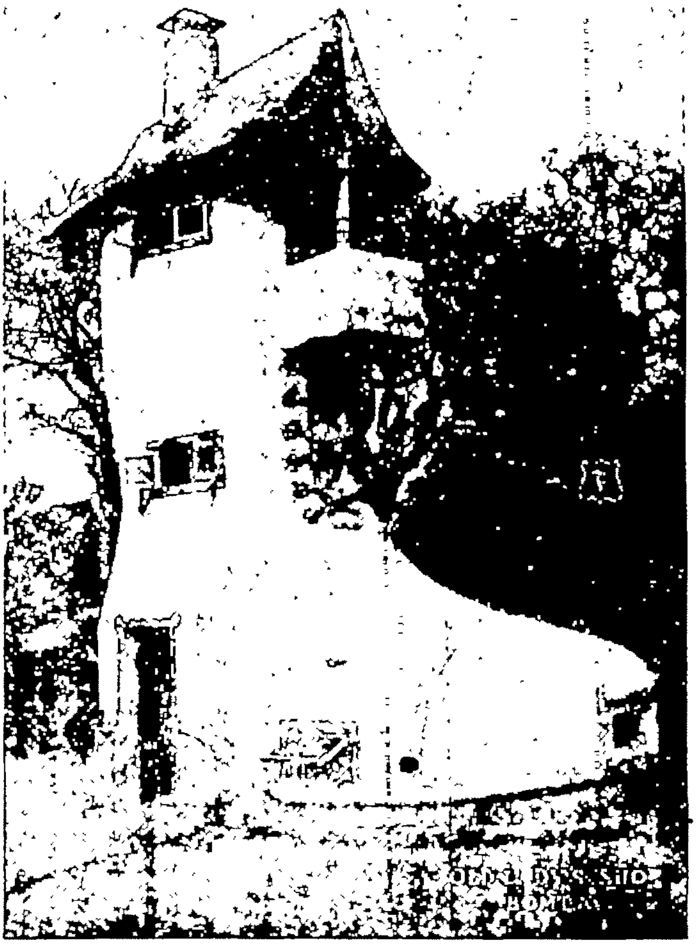


A Panoramic View of Marine Drive, Bombay

Hanging Gardens

From the Chowpatty beach we rise up the Malabar Hill, and atop the hill is Bombay's most popular beauty spot, Sir Pherozeshah Mehta Gardens and the Hanging Gardens. The Garden is laid out on the top as well as on the sides of the hill in rising layers. The plants grown in tiers give it the semblance of a garden suspended in air, whence it draws its fill. From the top one gets a panoramic view of the City, the Marine Drive, known as the 'Queen's Necklace', the bay, the colourful Chowpatty, the magnificent sky-line blazing by night with innumerable lights and the distant hills on the horizon. Adjacent to the Hanging Gardens, is another lovely spot of Bombay, the Kamala Nehru Park. It is a landscape garden with long winding pathways and green lawns, an enchanting fairyland for children. An enormous 'Shoe', an aquarium, an aviary, a quaint bridge, a stream and a fountain are its chief attraction.

It is named after the late wife of our beloved leader, late Pandit Jawaharlal Nehru.



THE OLD LADY'S SHOE INSIDE THE HANGING GARDENS, BOMBAY.

Mahalaxmi

Proceeding down Malabar and Cumballa Hills, we come to the Mahaluxmi temple, its stone walls and parapets washed by the surging waves of the sea. It is a place of pilgrimage during the *Navratris*, when thousands of Hindu devotees visit it. A few yards from here into the sea is Haji Ali's Darga, one of the oldest Muslim shrines in Bombay. At high tide the gangway leading up to the Darga is submerged under water and hence it could be visited only at low tide. Along Hornby Vallard, Bombay's other beautiful promenade, is the Race Course, one of the best in the world. Opposite to it is the Willingdon Club with wide spacious grounds for golf and lawn tennis.

Worli Sea Face

A little away from the crowded localities of the City, Worli Sea Face is yet another fine promenade by the sea and a delightful retreat for the evening strollers. At the northern end is the old fishing village of Worli and the fort, of which at the southern end is the Worli Dairy of the Bombay Milk Scheme, the biggest of its kind in India. The Worli Hill and the beautiful villas on the sloping ground provide an attractive background for this favourite haunt of the people.

Victoria Gardens

In the heart of the City are Bombay's zoological gardens, the well-known Victoria Gardens, which were laid out in 1861. The gardens occupy an extensive area with a very wide variety of flora and fauna. At the entrance, stands a giant monolithic elephant, which was originally brought from the Elephanta Caves on the island bearing the same name off the Bombay shore. With its extensive walks through trees, flower plants and bowers of a very wide variety and a beautiful lake for boating, the gardens are by far the most popular haunt of Bombay's citizens and also visitors to this City.

Mahatma Phule Market (Crawford Market)

The busiest shopping centre of the City is Mahatma Phule Market and the area surrounding it. Built in 1871, this market has sections for fruit, flowers, fish, meat and poultry under its roof. On the outskirts of the market, there are rows and rows of retail shops that cater for all wants and tastes. From this market fan out the City's big marketing lanes, each one of them devoted to one class of commodity ranging from hardware to jewellery.

Victoria Terminus

The Victoria Terminus, popularly known as Bori Bunder, is the main station and administrative headquarters of the Central Railway. Built in highly ornamental Gothic style, the V. T. is stated to be one of the most beautiful stations in the world and one of the biggest railway terminii of the east. Opposite to V. T. just across the road is the 225-ft. high building of the Bombay Municipal Corporation, which dominates the entire landscape here. A statue of Sir Pherozeshah Mehta, the doughty champion of civic rights, stands in front of the Corporation Building.

The Building of Bombay Municipal Corporation

Flora Fountain

Flora Fountain, the meeting place of five roads, is the very hub of Bombay's business activity. Within a walking distance from it, some of the most interesting institutions and buildings of Bombay are situated—the Bombay University, Maharashtra High Court, Town Hall which houses the Central Library, Central Telegraph offices, Old Secretariat, Elphinstone College and the Churchgate Station of the Western Railway.

THE FLORA FOUNTAIN VIEWED FROM A DISTANCE

Rajabai Tower

The 260-ft. high clock tower on the grounds of the University buildings, was built by Premchand Raichand, a well-known banker of Bombay, in the nineteenth century, as a memorial to his mother, Rajabai. The tower is a mixture of the Gothic and the early fifteenth century French styles. It has six storeys with an octagonal spire at the top and 24 carved figures in nitches.

THE PINNACLE OF RAJABAI TOWER, BOMBAY

PAPERS FOR TECHNICAL SESSIONS

The near-complete list of technical papers, printed in the seven Division parts of the *Journal*, scheduled for discussion in the different technical sessions is given below.

CIVIL ENGINEERING DIVISION

(1) Address by Shri K. K. Nambiar (*M.*) *Chairman*

(2) 'Urban Transportation' by P. G. Patankar (*M.*) (*Journal*, vol. 46, no. 5, pt. CI 3, January 1966)

(3) 'Use of Plastics in Building Construction' by Maj. A. S. Johur (*A.M.*) (*Journal*, vol. 46, no. 7, pt. CI 4, March 1966)

(4) 'Design Aspect of Prestressed Concrete Pavements' by V. K. Khosla (*Non-member*) and Dr. N. K. Vaswani (*A.M.*) (*Journal*, vol. 46 no. 9, pt. CI 5, May 1966)

(5) 'Design of Reinforced Concrete Grid Floors by Collapse-Load Method' by M. Das (*Non-member*) (*Journal*, vol. 46, no. 11, pt. CI 6, July 1966)

(6) 'An Investigation for the Prediction of True Ultimate Moment of Reinforced Concrete Beams' by Dr. Prakash Desayi (*A.M.*) and C. S. Viswanatha (*Non-member*) (*Journal*, vol. 46, no. 11, pt. CI 6, July 1966)

(7) 'India and Industrialized Buildings' by Maj. A. S. Johur (*A.M.*) (*Journal*, vol. 47, no. 5, pt. CI 3, January 1967)

(8) 'Hydrodynamic Pressures Generated During Earthquakes on Structures Surrounded by Water' by Bharat Singh (*A.M.*) and A. K. Jain (*Non-member*) (*Journal*, vol. 47, nos. 1 and 3, pts CI 1- CI 2, September-November 1966)

MECHANICAL ENGINEERING DIVISION

(1) 'Address by Maj.-Gen. S. P. Vohra (*M.*), *Chairman*

(2) 'Critical Speed of a Thin Rotating Disc with a Rigid Inclusion Welded at the Centre' by K. Chakrabarti (*Non-member*) (*Journal*, vol. 46, no. 5, pt. ME 3, January 1966)

(3) 'Manufacture of Diesel Locomotives in India' by V. A. Patel (*A.M.*) (*Journal*, vol. 46, no. 5, pt. ME 3, January 1966)

(4) 'Analysis of Vibrations in Machine Tools' by Dr. A. O. Schmidt, (*Non-member*), R. Frounfelkar (*Non-member*), and R. C. Achterberg (*Non-member*) (*Journal*, vol. 46, no. 5, pt. ME 3, January 1966)

(5) 'Method of Decreasing Dynamic Scatter in Finish Machining Process' by S. Somasundaram (*Non-member*) and B. K. Paryani (*Non-member*) (*Journal*, vol. 46, no. 5, pt. ME 3, January 1966)

(6) 'Rotary Regenerative Heat Exchanger—an Approach to Design for Parallel Flow' by Prof. V. F. Stepanchuk (*Non-member*) (*Journal*, vol. 46, no. 7, pt. ME 4, March 1966)

(7) 'Explosive Fabrication of Metals' by T. S. Chennabasavan (*Non-member*), and R. N. Singhal (*Non-member*) (*Journal*, vol. 46, no. 7, pt. ME 4, March 1966)

(8) 'Design of a Bicable Aerial Ropeway' by S. N. Ghosh (*Non-member*) and S. C. Jana (*A.M.*) (*Journal*, vol. 46, no. 7, pt. ME 4, March 1966)

(9) 'Design Construction and Calibration of a Two-Component Heavy Duty Lathe Dynamometer' by G. R. Ponkshe (*A.M.*) (*Journal*, vol. 46, no. 7, pt. ME 4, March 1966)

(10) 'Velocity Distribution in Heated Commercial Steel Pipes' by P. K. Sen (*A.M.*) and Dr. B. N. Chanda (*A.M.*) (*Journal*, vol. 46, no. 7, pt. ME 4, March 1966)

(11) 'Development of an Optoscope for Accurate Determination of Chip Reduction Coefficient in Metal Cutting' by J. Banerjee (*Non-member* and Dr. A. Bhattacharyya (*A.M.*) (*Journal*, vol. 46, no. 9, pt. ME 5, May 1966)

(12) 'Analysis of the Rate of Deformation at the Chip-Tool Contact Zone' by B. K. Mallick (*A.M.*) and Dr. A. Bhattacharyya (*A.M.*) (*Journal*, vol. 46, no. 9, pt. ME 5, May 1966)

(13) 'Mechanics of Drilling Process' by S. K. Bera (*Non-member*) and Dr. A. Bhattacharyya (*A.M.*) (*Journal*, vol. 46, no. 11, pt. ME 6, July 1966)

(14) 'Determination of Tool Forces During Operations by Tool-Force Dynamometers' by N. C. Das (*Non-member*), and B. K. Mallik (*A.M.*) (*Journal*, vol. 46, no. 11, pt. ME 6, July 1966)

(15) 'Kinematic Analysis of Quick-Return Mechanisms' by H. M. Ganesh Rao (*A.M.*) (*Journal*, vol. 46, no. 11, pt. ME 6, July 1966)

(16) 'A Study of the Grinding Process During Z-Z Method of Application of Cutting Fluids' by N. C. Kundu (*A.M.*), J. Banerjee (*A.M.*), B. P. Ghosh (*A.M.*). and Dr. A. Bhattacharyya (*A.M.*) (*Journal*, vol. 46, no. 11, pt. ME 6, July 1966)

(17) 'Nozzle Design—Prandtl-Meyer Expansion Method' by B. S. Jagadish (*Non-member*) and V. F. Stepanchuk (*Non-member*) (*Journal*, vol. 46, no. 11, pt. ME 6, July 1966)

(18) 'Anode Machining of Hard Metals by a Mild Steel Disc' by A. Mukherjee (*Non-member*), A. Ghosh (*Non-member*), and Dr. A. Bhattacharyya (*A.M.*) (*Journal*, vol. 46, no. 11, pt. ME 6, July 1966)

(19) 'Stabilization of Diffusion Flames by Opposed Jets' by T. Mukherjee (*Non-member*) and M. Achuthan (*A.M.*) (*Journal*, vol. 46, no. 11, pt. ME 6, July 1966)

(20) 'Optimum Pressure in a Two-Stage Reciprocating Compressor with Different Indices of Compression' by G. V. Ramanaiah (*Non-member*) and R. N. Reddy (*Student*) (*Journal*. vol. 46, no. 11, pt. ME 6, July 1966)

(21) 'Design of Traction-Pool Type Speed Variator' by I. N. Singh (*Non-member*) (*Journal*. vol. 46, no. 11, pt. ME 6, July 1966)

ELECTRICAL ENGINEERING DIVISION

(1) Address by Prof. H. C. Guha (*M.*), *Chairman*

(2) 'Design of an Electronic Voltage Regulation System for Improving Steady State Stability of Power Systems' by Dr. M. V. Hariharan (*Non-member*) and B. L. Mathur (*Non-member*) (*Journal*, vol. 46, no. 6, pt. EL 3, February 1966)

(3) 'Transient Performance of a Saturated Synchronous Machine under Unbalanced Load and Fault Conditions—2 : Solution of Transients' by P. K. Mukherjee (*Non-member*) (*Journal*, vol. 46, no. 6, pt. EL 3, February 1966)

(4) 'Effects of Short-Circuited Coils on the Performance of Schrage Motor' by Prof. C. V. Govinda Rao (*M.*) (*Journal*, vol. 46, no. 6, pt. EL 3, February 1966)

(5) 'Important Aspects of Integrated Systems Operation' by S. A. Quader (*M.*) (*Journal*, vol. 46, no. 6, pt. EL 3, February 1966)

(6) 'Recent Developments in Biquadratic Immittance Function Synthesis' by C. R. Sastri (*Non-member*) (*Journal*, vol. 46, no. 6, pt. EL 3, February 1966)

(7) 'Derivation of the Transients of a Saturated Synchronous Machine Equipped with Voltage Regulators' by P. K. Mukherjee (*Non-member*) (*Journal*, vol. 46, no. 8, pt. EL 4, April 1966)

(8) 'A Generalized Theory of Protective Relays and Its Application to Distance Protection—1 : Theory' by Dr. S. P. Patra (*A.M.*) and S. R. Bandyopadhyay (*Non-member*) (*Journal*, vol. 46, no. 8, pt. EL 4, April 1966)

(9) 'Measurement of Synchronous Machine Power Angle' by S. M. Peeran (*Non-member*) and B. L. Mathur (*Non-member*) (*Journal*, vol. 46, no. 8, pt. EL 4, April 1966)

(10) 'Solution of the Problem of Peak Demand in the Southern Regional Grid' by S. A. Quader (*M.*) (*Journal*, vol. 46, no. 8, pt. EL 4, April 1966)

(11) 'Lightning Protection of Directly Connected Rotating Machines' by N. Rama Rao (*Non-member*) and B. V. Dutt (*Non-member*) (*Journal*, vol. 46, no. 8, pt. EL 4, April 1966)

(12) 'Temperature Rise in Stator Winding of a Three-Phase Induction Motor Connected to Unsymmetrical Supply' by Dr.-Ing. N. N. Roy (*A.M.*) (*Journal*, vol. 46, no. 8, pt. EL 4, April 1966)

(13) 'A Circuit for the Synthetic Testing of Vacuum Circuit-Breaker—1 : the Main Circuit' by D. G. Tamaskar (*A.M.*) (*Journal*. vol. 46, no. 8, pt. EL 4, April 1966)

(14) 'A Distortion Eliminator *cum* Distortion Analyzer for Power Frequency Mains Supply' by Prof. J. K. Choudhury (*A.M.*) and D. P. Chakrabarty (*A.M.*) (*Journal*, vol. 46, no. 10, pt. EL 5, June 1966)

(15) 'Transient Reversal of Under-Rated Low Inertia Single-Phase Squirrel Cage Induction Motors' by Dr. A. K. Das Gupta (*M.*) (*Journal*, vol. 46, no. 10, pt. EL 5, June 1966)

(16) 'Application of the Monte Carlo Method for the Evaluation of the Transfer and Driving-Point Admittance of a System' by Dr. S. Das Gupta (*A.M.*) and Dr. A. K. Roy (*Non-member*) (*Journal*, vol. 46, no. 10, pt. EL 5, June 1966)

(17) 'Application of the Monte Carlo Games in the Analysis of A.C. Networks—2' by Dr. S. Das Gupta (*A.M.*) and Dr. A. K. Roy (*Non-member*) (*Journal*, vol. 46, no. 10, pt. EL 5, June 1966)

(18) 'A Review of the Present Status of Solar Energy Utilization' by V. K. Maitreya (*Non-member*) (*Journal*, vol. 46, no. 10, pt. EL 5, June 1966)

(19) 'Analysis of Power System Fault Study in A.C. Network Calculator and a Proposed Method for Considering All Circuit Elements with One Generator' by S. R. Sikdar (*A.M.*) (*Journal*, vol. 46, no. 10, pt. EL 5, June 1966)

(20) 'Steady State Heating of Induction Motors under Unbalanced Conditions' by S. Srinivasan (*M.*) (*Journal*, vol. 46, no. 10, pt. EL 5, June 1966)

(21) 'Electrical Insulating Oxide Films on Aluminium' by Prof. B. M. Tareev (*Non-member*) (*Journal*, vol. 46, no. 10, pt. EL 5, June 1966)

(22) 'Studies on Failure of Distribution Transformers' by A. Venkateswara Rao (*A.M.*) (*Journal*, vol. 46, no. 10, pt. EL 5, June 1966)

(23) 'Transient Thermal Response of Building Fabrics by Electrical Analogue Method' by (Mrs.) Kamalesh Arora (*Non-member*) (*Journal*, vol. 46, no. 12, pt. EL 6, August 1966)

(24) 'A Modified Method of Calculation for Obtaining Stringing Chart of Overhead Transmission Line' by R. N. Basu (*Non-member*) and S. N. Dutta (*Non-member*) (*Journal*, vol. 46, no. 12, pt. EL 6, August 1966)

(25) 'Measurement of Incremental Magnetic Loss by Bridge and Wattmeter Methods' by R. K. Mondal (*Non-member*), S. N. Bhattacharyya (*A.M.*), and Prof. J. K. Choudhury (*A.M.*) (*Journal*, vol. 46, no. 12, pt. EL 6, August 1966)

(26) 'Transfer Function of Two-Phase Servomotor' by J. S. Gupta (*A.M.*) (*Journal*, vol. 46, no. 12, pt. EL 6, August 1966)

(27) 'Minimum Transit Time and Electricity for City Electric Traction' by Dr. V. K. Jain (*A.M.*) and W. E. Thompson (*Non-member*) (*Journal*, vol. 46, no. 12, pt. EL 6, August 1966)

(28) 'A Generalized Theory of Protective Relays and Its Application to Distance Protection—2 : Application' by Dr. S. P. Patra (*A.M.*) and S. R. Bandyopadhyay (*Non-member*) (*Journal*, vol. 46 no. 12, pt. EL 6, August 1966)

(29) 'Equivalent Circuit for a Multi-Winding Transformer' by Dr. P. V. Ratnam (*Non-member*) and C. K. Sarma (*Non-member*) (*Journal*, vol. 46, no. 12, pt. EL 6, August 1966)

(30) 'Application of a Capacitor with the Arno 1:3-Phase Convertor' by T. V. Sreenivasan (*A.M.*) (*Journal*, vol. 46, no. 12, pt. EL 6, August 1966)

(31) 'Application of Equivalence Technique in Linear Graph Theory to Reduction Process in a Power System' by Prof. S. Srinivasan (*M.*), V. N. Sujeer (*A.M.*) and K. Thulasiraman (*Non-member*) (*Journal*, vol. 46, no. 12, pt. EL 6, August 1966)

(32) 'A Circuit for the Synthetic Testing of Vacuum Circuit-Breaker—2 : The Control Circuit' by D. G. Tamaskar (*A.M.*) (*Journal*, vol. 46, no. 12, pt. EL 6, August 1966)

(33) 'Selection of Capacitors for Rectifier Devices' by Prof. B. M. Tareev (*Non-member*) and M. M. Lerner (*Non-member*) (*Journal*, vol. 47, nos. 2 & 4, pt. EL 1-2, October-December 1966)

(34) 'Grounding Resistance of Straight Horizontal Conductor in Non-Uniform Soil' by B. Thapar (*Non-member*) (*Journal*, vol. 46, no. 12, pt. EL 6, August 1966)

ELECTRONICS AND TELECOMMUNICATION ENGINEERING DIVISION

(1) Address by Brig. M. K. Rao (*M.*), *Chairman*

(2) 'Network Structures for a Special Class of Minimum Biquartic *PR*-Functions' by J. G. Advani (*Non-member*) and O. P. Gupta (*Non-member*) (*Journal*, vol. 46, no. 5, pt. ET 2, January 1966)

(3) 'Synthesis of An A.C. Lead Transfer Function for Minimum Sensitivity by Parallel Ladder Procedure' by J. G. Advani (*Non-member*) and B. Kesavan (*Non-member*) (*Journal*, vol. 46, no. 5, pt. ET 2, January 1966)

(4) 'Transistor Rectangular Pulse Generator' by R. R. Mehrotra (*Non-member*), Harbans Lal (*Non-member*), and B. K. Tyagi (*Non-member*) (*Journal*, vol. 46, no. 5, pt. ET 2, January 1966)

(5) 'Waveform Analysis of E.D.A. Solutions and Determination of Describing Functions with the Vectormeter' by B. N. Nityanandan (*Non-member*) (*Journal*, vol. 46, no. 9, pt. ET 3, May 1966)

(6) 'Single Transistor Voltage Controlled Oscillator and Its Application by K. Gangadharan Nadar (*A.M.*) (*Journal*, vol. 47, no. 1, pt. ET 1, September 1966)

(7) 'Fluctuation Theory of Luminance Discrimination for the Light-Adopted Eye and Its Particular Application to the TV Case' by P. S. Moharir (*Non-member*) (*Journal*, vol. 47, no. 1, pt. ET 1, September 1966)

(8) 'Gray Scale Properties of the Eye' by P. S. Moharir (*Non-member*) and K. V. Saprykin (*Non-member*) (*Journal*, vol. 47, no. 1, pt. ET 1, September 1966)

CHEMICAL ENGINEERING DIVISION

(1) Address by Dr. V. M. Dokras (*M.*), *Chairman*

(2) 'Need for Gas Turbine Power Plants in a Refinery' by S. K. Goyal (*Non-member*) (*Journal*, vol. 46, no. 6, pt. CH 2, February 1966)

(3) 'Metallizing of Structural Steelwork and Its Application in Pamban Railway Bridge' by R. Nagarajan (*A.M.*) (*Journal*, vol. 46, no. 6, pt. CH 2, February 1966)

(4) 'Cokeoven Gas Feedstock for the Manufacture of Ammonia with Special Reference to the Proposed Talcher Industrial Complex' by Dr. H. P. Mishra (*Non-member*), and D. Panigrahi (*Non-member*) (*Journal*, vol. 47, no. 2, pt. CH 1, October 1966)

MINING AND METALLURGY DIVISION

(1) Address by Dr. G. P. Chatterjee (*M.*), *Chairman*

(2) 'Current Researches in Coal Mining in Some West European Countries and Their Probable Application in Indian Coal Mines' by R. D. Singh (*A.M.*) (*Journal*, vol. 46, no. 7, pt. MM 2, March 1966)

(3) 'Investigation into the Production of Pig Iron for High Grade Malleable Cast Iron and Spheroidal Graphite Cast Iron in an Experimental Hot Blast Cupola' by K. C. Choudhuri (*Non-member*), and N. V. Pandit (*Non-member*) (*Journal*, vol. 46, no. 11, pt. MM 3, July 1966)

(4) 'Dust in Mines' by R. S. Mishra (*A.M.*) (*Journal*, vol. 46, nc. 11, pt. MM 3, July 1966)

(5) 'The Notched-Bar Impact Properties of Silico-Manganese Steel' by D. V. Reddi (*A.M.*), S. K. Dutta (*Non-member*), and P. S. Ramaswamy (*Non-member*) (*Journal*, vol. 46, no. 11, pt. MM 3, July 1966)

(6) 'Training of Mining Engineers in Britain and the United States' by R. K. Singhal (*Non-member*), and C. W. Berry (*Non-member*) (*Journal*, vol. 46, no. 11, pt. MM 3, July 1966)

(7) 'Some Problems Relating to Ground Stresses' by R. S. Mishra (*A.M.*) (*Journal*, vol. 47, no. 3, pt. MM 1, November 1966)

(8) 'Bimetallic Welding' by Dr. B. Prakash (*Non-member*) (*Journal*, vol. 47, no. 3, pt. MM 1, November 1966)

(9) 'Logistics in Steelmaking' by F. W. Rys (*Non-member*), R. Easton (*Non-member*), and R. E. Powers (*Non-member*) (*Journal*, vol. 47, no. 3, pt. MM 1, November 1966)

(10) 'Recovery of Lead and Zinc from Lead Blast Furnace Slag' by Prof. S. Sarkar (*A.M.*) (*Journal*, vol. 47, no. 3, pt. MM 1, November 1966)

PUBLIC HEALTH ENGINEERING DIVISION

(1) Address by K. N. Rohatgi (*M.*), *Chairman*

(2) 'Evaporation Control by Use of Monomolecular Films and Experimental Work Done at Vehar Lake' by S. R. Kshirsagar (*A.M.*) (*Journal*, vol. 46, no. 6, pt. PH 2, February 1966)

(3) 'Hydrogen Sulphide in Concrete Sewers and Digesters' by G. J. Mohanrao (*A.M.*), C. A. Sastry (*Non-member*), and W. F. Garber (*Non-member*) (*Journal*, vol. 46, no. 6, pt. PH 2, February 1966)

(4) 'Maintenance of Hand Pumps Fitted to Small Diameter Tubewells in Rural Areas' by N. Majumdar (*M.*) and S. Subba Rao (*A.M.*) (*Journal*, vol. 46, no. 10, pt. PH 3, June 1966)

(5) 'Oxidation Ponds for Vijayawada in Andhra Pradesh' by Y. S. Murti (*A.M.*), R. R. Harris (*Non-member*), M. Govindiah (*A.M.*) and G. K. Seth (*Non-member*) (*Journal*, vol. 46, no. 10, pt. PH 3, June 1966)

(6) 'A Simplified Sewage Purification Process for Small Quantities of Domestic Sewage and Industrial Wastes' by C. J. Shah (*A.M.*) (*Journal*, vol. 46, no. 10, pt. PH 3, June 1966)

(7) 'Dilution of Sewage for Irrigation' by O. P. Bishnoi (*M.*) (*Journal*, vol. 47, no. 2, pt. PH 1, October 1966)

(8) 'Some Aspects of Economy in Sanitary Plumbing—2 : Junction of a House Sewer with the Municipal Sewer' by R. C. Singh (*A.M.*) (*Journal*, vol. 47, no. 2, pt. PH 1, October 1966)

(9) 'A Study on Radio-activity in Rain Water' by Dr. H. L. Uppal (*M.*) and Tarlok Singh (*Non-member*) (*Journal*, vol. 47, no. 2, pt. PH 1, October 1966)

PRESTRESSED CONCRETE GROUP

(1) Address by Shri K. F. Antia (*M.*), *Chairman*

(2) 'Linear Graph Theory Applied to Structures—1 : Continuous Beams' by P. S. Satsangi (*A.M.*) and V. K. Garg (*Non-member*) (*Journal*, vol. 46, no. 5, pt. CI 3, January 1966)

(3) 'Precast Prestressed Concrete Trussed Girder' by Dr. K. K. Banerjee (*A.M.*) and K. D. Banerjee (*Non-member*) (*Journal*, vol. 46, no. 11, pt. CI 6, July 1966)

(4) 'Design Aspects and Manufacture of Prestressed Concrete Girders of 40-ft. Span on the N.E. Railway' by B. B. Dutta (*M.*) (*to be published*)

SHELL STRUCTURES GROUP

(1) Address by Shri G. S. Ramaswamy, (*M.*), *Chairman*

(2) 'A Survey of Numerical Procedures for the Analysis of Plate and Shell Problems' by Dr. J. R. Desai (*Non-member*) (*Journal*, vol. 46, no. 9 pt. CI 5, May 1966)

(3) 'Analysis of Thin Elastic Cylindrical Shells by Finite Element Method' by S. Chakrabarti (*Non-member*) (*Journal*, vol. 47, no. 5, pt. CI 3, January 1967)

(4) 'Circular Plates Carrying Linearly Varying Load' by Dr. A. S. Arya (*A.M.*) and A. S. Pathak (*Non-member*) (*to be published*)

(5) Doubly Curved Shells in Oblique Co-ordinate System' by S. P. Banerjee (*M.*) (*to be published*)

RAILWAY ENGINEERING GROUP

(1) Address by Shri D. N. Chopra (*M.*), *Chairman*

(2) 'Studies on Railway Accidents—3 : Cost of Accidents' by T. C. Sarkar (*Non-member*) and C. P. S. Ayyar (*Non-member*) (*Journal*, vol. 46, no. 5, pt. CI 3, January 1966)

(3) 'Some Aspects in the Design of Plate Girders for Curved Railway Tracks' by R. Nagarajan (*A.M.*) and S. Krishnaswamy (*Student*) (*Journal*, vol. 46, no. 9, pt. CI 5, May 1966)

(4) 'Some Aspects of Selection, Design and Capacity of Diesel Hydraulic Locomotives' by V. A. Patel (*A.M.*) (*Journal*, vol. 46, no. 11, pt. CI 6, July 1966)

INDUSTRIAL ENGINEERING GROUP

(1) Address by Shri R. M. Patri (*M.*), *Chairman*

(2) 'Mathematical Programming in Production Control—2' by T. L. Subramanian (*Non-member*) and C. A. Gilpin (*Non-member*) (*Journal*, vol. 46, no. 7, pt. ME 4, March 1966)

(3) 'Effect of Machine Control and Cycle Time on Working Pace' by K. Chandra Mouli (*Non-member*) and N. K. Datta (*A.M.*) (*Journal*, vol. 46, no. 9, pt. ME 5, May 1966)

(4) 'Human Side—A Challenge to Engineering Management' by Mahesh Varma (*A.M.*) (*Journal*, vol. 46, no. 9. pt. ME 5, May 1966)

(5) 'Operations Research in Industrial Management' by V. L. N. Row (*M.*), (*Journal*, vol. 46, no. 9, pt. ME 5, May 1966)

(6) 'The Assembly Line Balancing Problem' by K. C. Sahu (*A.M.*) (*Journal*, vol. 46, no. 9. pt. ME 5, May 1966)

AUTOMATIC CONTROL GROUP

(1) Address by V. V. Sarwate (*M.*), *Chairman*

(2) 'A Technique of Characterization and Equivalent Model Construction of a Class of Nonlinear Systems' by D. N. Khandelwal (*Non-member*) (*Journal*. vol. 47, no. 1, pt. ET 1, September 1966)

PETROLEUM ENGINEERING GROUP

(1) Address by Dr. A. Lahiri (*M.*), *Chairman*

(Further programme will be announced later)

NUCLEAR ENGINEERING GROUP

(Chair Vacant)

(1) 'Stability Boundaries Varriation due to Delayed Neutron Representation in a Graphite Power Reactor' by V. R. Sastry (*Non-member*) and G. S. Deep (*Non-member*) (*Journal*, vol 46, no 12, pt. EL 6, August 1966)

MARINE ENGINEERING AND SHIPBUILDING GROUP

(1) Address by Shri S. Basu (*M.*), *Chairman*

(Details to be announced later)

AERONAUTICAL ENGINEERING GROUP

The Chair of the Aeronautical Engineering Group is vacant at present and there are no papers for discussion in this Group.

OUTSTATION TOUR NO. 1 : BOMBAY CENTRAL—BARODA—TARAPUR—BOMBAY CENTRAL

Departure station	Date of departure	Train No.	Departure time	Destination	Arrival time	Date	Places of visits (Industries)	Charge per person
Bombay Central	28.2.1967	No. 1 Dn.	21.40	Baroda	4.21	1.3.1967	8.30 Jyoti Ltd. 10.15 Sarabhai Works	Rs. 95.00
Bombay Central	20.2.1967	No. 19 Dn.	22.25	Baroda	5.58	1.3.1967	12.30 Lunch (Courtesy Sarabhai Machinery Group) 14.00 Alembic Works 15.30 Koyali Refinery 17.00 Tea 20.00 Dinner (Courtesy Jyoti Ltd.)	
Baroda Junction	1.3.1967	No. 20 Up	22.03	Palghar	3.00	2.3.1967	6.30 Transfer in ST Buses 7.00 Arrive Guest House at Boisar	
Baroda Junction	2.3.1967	No. 2 Up	0.18	Palghar	4.45	2.3.1967	7.00 to 8.00 Bath and Breakfast 8.30 to 12.30 Visit Tarapur Atomic Reactor 13.00 to 14.00 Lunch 14.00 to 15.00 Visit colony 15.00 Leave for Palghar (1st batch) 15.30 Arrive Palghar 16.00 Leave for Palghar after tea (2nd batch) 16.30 Arrive Palghar (transfer in respective railway coaches)	
Palghar (1st batch)	2.3.1967	No. 46 Up	16.21	Bombay Central	19.50	2.3.1967		
Palghar (2nd batch)	2.3.1967	No. 16 Up	17.05	Bombay Central	19.25	2.3.1967		

TOUR NO. 2—BOMBAY VICTORIA TERMINUS—KOYNA DAM—BOMBAY VICTORIA TERMINUS

Departure station	Date of departure	Train No.	Departure time	Destination	Arrival time	Date	Places of visits		Charge per person
Bombay V.T.	28.2.1967	325 Dn.	23.30	Poona	5.35	1.3.1967	7.30	Leave for Koyna by bus	Rs. 85.00
							12.00	Arrive Koyna	
							12.00 to 14.00	Lunch at Koyna	
							14.00	Leave for Pophali	
							15.00 to 18.00	Visit to Pophali Power House	
							19.00	Arrive Koyna Dinner and stay overnight at Koyna Rest House	
						2.3.1967	8.00 to 11.00	Visit to Koyna Dam, etc.	
							11.00 to 14.00	Lunch at Koyna	
							14.00	Leave for Poona	
							19.30	Arrive Poona	
							20.00	Dinner at Poona	
Poona	2.3.1967	322 Up	2.30	Bombay V.T.	6.25	3.3.1967			

TOUR NO. 3 - BOMBAY VICTORIA TERMINUS—POONA—BOMBAY VICTORIA TERMINUS

Departure station	Date of Departure	Train No.	Depature time	Destination	Arrival time	Date	Places of visits (Industries)	Charge per person
Bombay VT	28.2 1967	325 Dn.	23 30	Poona	5.35	1 3.1967	8.00 to 9.30 Kirloskar Oil Engines	Rs. 50.00
							10.00 to 11.30 Cooper Engineering (tea and snacks)	
							11.45 to 13 15 Bajaj Auto and Bajaj Tempo	
							13.30 to 14.30 Lunch (Courtesy Bajaj Auto & Tempo)	
							14.45 to 15.45 Hindustan Antibiotics	
							16.00 to 16.30 J. G. Glass Industries (also tea)	
							19.30 Dinner (Courtesy Kirloskar Oil Engines)	
Poona	1.3.1967	322 Up	23.30	Bombay VT	6.25	2.3.1967		

TOUR NO. 4 BOMBAY VT—ELLORA—AJANTA—AURANGABAD (via Jalgaon)—BOMBAY VT

Departure station	Date of departure	Train No	Departure time	Destination	Arrival time	Date	Places of visits		Charge per person
Bombay VT	28.2 1967	57 Dn.	21 45	Jalgaon	5 35	1.3.1967	6.00	Leave Jalgaon in ST buses after tea	Rs. 160 00
							7 30	Arrive Fardapur Guest House (bath and Breakfast)	
							9.30	Arrive Ajanta	
							13.30	Lunch and rest at Fardapur Guest House	
							14 30	Leave for Aurangabad	
							17 30	Arrive Aurangabad—visit Bibi-ka-Maqbara, Panchakki, etc., after tea	
							20.30	Dinner and night at Aurangabad in hotels	
						2 3 1967	7.00	Breakfast	
							8.30	Daulatabad Fort	
							9.30	Leave for Ellora	
							10.00 to 13.00	Ellora Caves	
							13.30 to 15 50	Lunch and rest in Hotel at Aurangabad	
							16.00	Leave Aurangabad for Fardapur	
							19.00	Arrive Faradpur Guest House for rest and dinner	
							20.30	Leave Fardapur Guest House for Jalgaon	
Jalgaon	2.3.1967	30 Up	22.41	Bombay VT	8.15	3.3.1967			

HOTELS AND OTHER FACILITIES IN BOMBAY

Members are requested to select their hotel accommodation from the list below and also furnish an alternative choice. The full amount in respect of the accommodation for the number of days desired should be remitted to **The Honorary Secretary, Bombay Centre, Institution of Engineers (India), Ilaco House, Sir P. M. Road . Bombay-1**, as early as possible, but in any case, **not later than January 31, 1967**, specifying the name of the hotel.

Accommodation at	Number of rooms		Rate per day		With or without food	Type of food available if required	Advance notice for reservation	Remarks (extra charges)
	Single	Double	Single room one person	Double room two persons				
Taj Mahal Hotel Apollo Bunder *Telephone* 214221	10	5	Rs. 70	Rs. 120	With food	Serves vegetarian and non-vegetarian food	4 weeks	Room service + 10% service charge extra
Ritz Hotel Churchgate Reclamation *Telephone* 245061	10	5	Rs. 62	Rs. 90	With food	Serves vegetarian and non-vegetarian food	4 weeks	Porterage, service charge 10%, Sales tax
Airlines Hotel Churchgate Reclamation *Telephone* 249176	10	5	Rs. 50 & 56	Rs. 96	With food	Serves vegetarian and non-vegetarian food	4 weeks	Porterage, service charge 10%, Sales tax
Ambassador Hotel Churchgate Reclamation *Telephone* 241131	10	5	Rs. 66.10	Rs. 110.59 & 117.79	With food	Serves vegetarian and non-vegetarian food	7 weeks	Porterage, service charge 10% Sales tax
Astoria Hotel Churchgate Reclamation *Telephone* 249171	10	5	Rs. 35	Rs. 59	With food	Serves vegetarian and non-vegetarian food	4 weeks	Service charge air-condition charge Rs. 12

HOTELS AND OTHER FACILITIES IN BOMBAY—*Contd.*

Accomodation at	Number of rooms		Rate per day		With or without food	Type of food available if required	Advance notice for reservation	Remarks (extra charges)
	Single	Double	Single room one person	Double-room two persons				
M.L.A. Hostel Near Sachivalaya *Telephone* 245141	100	15	Rs. 10	Rs. 15	Without food	Serves vegetarian and non-vegetarian food	2 weeks	Lodging only. Food and others services extra
Sea-Green (South) Marine Drive *Telephone* 245405	20	20	Rs. 25	Rs. 37.30	With food	Serves vegetarian and non-vegetarian food	2 weeks	
Shalimar Hotel Cumballa Hill *Telephone* 362521	20	20	Rs. 40	Rs. 52	Bed and morning tea without food	Serves vegetarian and non-vegetarian food	4 weeks	Food and other services extra
Metropole Hotel Pelton Road *Telephone* 262086	20	20	Rs. 15	Rs. 23	Bed and morning tea without food	Serves vegetarian and non-vegetarain food	2 weeks	Food and other services extra
Parkway Hotel Shivaji Park *Telephone* 451281	20	20	Rs. 32 (air-conditioned)	Rs. 29 (without air-conditioned) Rs. 55 (air-conditioned)	Bed and morning tea without food	Serves vegetarian and non-vegetarian food	2 weeks	Food and other services extra

FORTY-SEVENTH ANNUAL CONVENTION

BOMBAY, FEBRUARY 24-28, 1967

ACCEPTANCE FORM FOR DELEGATES

Original—to be sent to :

The Honorary Secretary,
Bombay Centre,
Institution of Engineers (India),
Ilaco House, Sir.P. M. Road, Bombay-1.

This form together with the necessary remittance in respect of self and accompanying guests for Hotel Accommodation, Registration, Annual Dinner. Outstation Tours (if participating) and Bank Discount on outstation cheques, should positively reach the Bombay Centre **not later than January 31, 1967,** Forms received after that date or without advance remittance, as also provisional forms, will not be accepted, and no reservations will be handled in such cases. Requests for all these reservations will be dealt with and confirmed (if time permits) in the order in which the forms are received.

(Please fill in block letter)

Name ....

Grade and Membership No. ....

Your Local Centre ....

Address for communication ....

....

....

Arrival, accommodation and return travel

I, accompanied by ......lady/ladies. . .gentleman, gentlemen and. . servant/s will arrive in Bombay from ... .by............train/...... air service on February....., 1967, at ......a.m./p.m. I/We desire/do not desire** to be met at Dadar (W. Rly.)/Dadar (C. Rly.)/Bombay Central Bombay Victoria Terminus/Railway Station/Santacruz Airport/I.A.C. City Booking Office** and require/do not require** transport to the hotel fixed for me/us**.

I/We desire/do not desire** to reserve accommodation during our stay at Bombay for..... . days from February .... . to February .. .. 1967 (both days inclusive) in......... .... as a first choice and ... ...as a second choice.@@

I/We desire/do not desire** travel reservation by ... . . train/.... .. .. air service for return journey to .. . .. . on February/March, ... 1967.

**Please retain your choice and strike off the other

@@ Indicate your choice from the list of hotels given in the earlier page

Payments for Reservations

I enclose a cheque*/Draft*/have sent a money order for Rs. .... to cover the following payments :

1.	Hotel Accommodation for ...... persons at Rs....... per person for .... days from February .... to February ...... 1967 (both days inclusive) (...... Hotel first choice .... Hotel second choice....)	Rs.
2.	Registration Fee for self (Rs. 20.00 per member other than Students and Rs. 10.00 per student)	Rs.
3.	Registration Fee (Rs. 15.00 per lady guest) for........ Lady/Ladies.	Rs.
4.	Annual Dinner (Rs. 15.00 each for Corporate Members, Graduates and their Gentlemen Guests and Rs. 10.00 per Student and Lady Guest) for........ Gentleman/Gentlemen and Lady/Ladies.	Rs.
5.	Outstation Tour No. 1/Tour No. 2/Tour No. 3/Tour No. 4 (Rs. ...... for Tour No. 1/Rupees .... for Tour No. 2/Rupees .... for Tour No. 3/ Rupees .... for Tour No. 4 for ....person/s.	Rs.
6.	Bank Discount on outstation cheques (62 Paise per Rs. 100/- or part thereof)	Rs.
	Total	Rs.

---

*Cheques should be made in the name of The Institution of Engineers (India), Bombay Centre

Participation requirements

Date	I/We** desire to attend	Indicate your requirements	
Friday, February 24, 1967	Meeting of the Indian National Committee for World Power Conference	YES	NO
	Special General Meeting	YES	NO
	Business Meeting of the 47th Annual General Meetings	YES	NO
	Panel Meetings	YES	NO
Saturday, February 25, 1967	Inauguration of the 47th Annual General Meeting	YES	NO
	Lunch—Vegetarian/Non-vegetarian	YES	NO
	The Tenth Sir Mokshagundam Vievesvaraya Lecture	YES	NO
	Technical Paper Meetings (1st session)	YES	NO
	Entertainment	YES	NO
	At Home	YES	NO
Sunday, February 26, 1967	Annual Meeting, Bombay Centre	YES	NO
	Seminar	YES	NO
	Lunch—Vegetarian/Non-vegetarian	YES	NO
	Engineering Education and Research Committee Meeting	YES	NO
	Technical } Session of the	YES	NO
	General } Student Members	YES	NO
	Annual Banquet—Vegetarian/Non-vegetarian	YES	NO
	Entertainments	YES	NO
Monday, February 27, 1967	Technical Paper Meeting (2nd session)	YES	NO
	Lunch—Vegetarian/Non-vegetarian	YES	NO
	Technical Paper Meeting (3rd session)	YES	NO
	Nidhu Bhusan Memorial Lecture	YES	NO
	Entertainments	YES	NO
	Ladies Programme (as per details given in the earlier pages)	YES	NO
Tuesday, February 28, 1967	**Local Visits**		
	No. 1/No. 2/No. 3/No. 4/No. 5	YES	NO
	Lunch/Vegetarian/Non-Vegetarian	YES	NO
	Popular Lecture—2.30 to 4.30 P.M.	YES	NO
	Closing Session of the 47th Annual General Meeting	YES	NO

Outstation Tours

I/We desire to join Tour No............. as a first choice*

Tour No............... as a second choice

Date................ *Signature*......................

****Please retain your choice and strike off the other.**

FORTY-SEVENTH ANNUAL CONVENTION

BOMBAY, FEBRUARY 24-28, 1967

ACCEPTANCE FORM FOR DELEGATES

(Duplicate to be retained by the Delegate)

This form together with the necessary remittance in respect of self and accompanying guests for Hotel Accommodation, Registration, Annual Dinner, Outstation Tours (if participating) and Bank Discount on outstation cheques, should positively reach the Bombay Centre **not later than January 31, 1967.** Forms received after that date or without advance remittance, as also provisional forms, will not be accepted, and no reservations will be handled in such cases. Requests for all these reservations will be dealt with and confirmed (if time permits) in the order in which the forms are received.

(Please fill in block letter)

Name . . . .

Grade and Membership No. . . . .

Your Local Centre . . . .

Address for communication . . . .

. . . .

. . . .

Arrival, accommodation and return travel

I, accompanied by . . . . .lady/ladies, ...gentleman/gentlemen and. . . servant/s will arrive in Bombay from . . . . by. . . . . .train/. . air service on February. . . . ., 1967, at . . . . . .a.m./p.m. I/We desire/do not desire** to be met at Dadar (W. Rly.)/Dadar (C. Rly.)/Bombay Central/ Bombay Victoria Terminus/Railway Station/Santa cruz Airport/I.A.C. City Booking Office** and require /do not require** transport to the hotel fixed for me/us**.

I/We desire/do not desire** to reserve accommodation during our stay at Bombay for . . . . days from February . . . to February, ... 1967 (both days inclusive) in . . . . as a first choice/ and . . . . as a second choice.@@

I/We desire/do not desire** travel reservation by . . . . train/. . . . . air service for return journey to . . . . .on February/March, ... 1967.

****Please retain your choice and strike off the other.**

@@Indicate your choice from the list of hotels given in the earlier page.

Payments for Reservations

I enclose a cheque*/Draft*/have sent a money order for Rs............ to cover the following payments :

1. Hotel Accommodation for...... persons at Rs....... per person for .... days from February .... to February ...... 1967 (both days inclusive) ...... Hotel first choice........ Hotel second choice....) Rs.
2. Registration Fee for self (Rs. 20.00 per member other than Students and Rs. 10.00 per student) .... Rs.
3. Registration Fee (Rs. 15.00 per lady guest) for........ Lady/Ladies. .... Rs.
4. Annual Dinner (Rs. 15.00 each for Corporate Members, Graduates and their Gentlemen Guests and Rs. 10.00 per Student and Lady Guest) for . ... Gentleman/Gentlemen and Lady/Ladies. .... Rs.
5. Outstation Tour No. 1/Tour No. 2/Tour No. 3/Tour No. 4 (Rs. ...... for Tour No. 1/Rupees .... for Tour No. 2/Rupees .... for Tour No. 3/ Rupees .... for Tour No. 4 for ....person/s. .... Rs.
6. Bank Discount on outstation cheques (62 Paise per Rs. 100/- or part thereof) .... Rs.

Total .... Rs.

---

*Cheques should be made in the name of The Institution of Engineers (India), Bombay Centre

Participation requirements

Date	I/We** desire to attend	Indicate your requirements	
Friday, February 24, 1967	Meeting of the Indian National Committee for World Power Conference	YES	NO
	Special General Meeting	YES	NO
	Business Meeting of the 47th Annual General Meetings	YES	NO
	Panel Meetings	YES	NO
Saturday, February 25, 1967	Inauguration of the 47th Annual General Meeting	YES	NO
	Lunch—Vegetarian/Non-vegetarian	YES	NO
	The Tenth Sir Mokshagundam Visvesvaraya Lecture	YES	NO
	Technical Paper Meetings (1st session)	YES	NO
	Entertainment	YES	NO
	At Home	YES	NO
Sunday, February 26, 1967	Annual Meeting, Bombay Centre	YES	NO
	Seminar	YES	NO
	Lunch—Vegetarian/Non-vegetarian	YES	NO
	Engineering Education and Research Committee meeting	YES	NO
	Technical ⎫ Session of the	YES	NO
	General ⎭ Student Members	YES	NO
	Annual Banquet—Vegetarian/Non-vegetarian	YES	NO
	Entertainments	YES	NO
Monday, February 27, 1967	Technical Paper Meeting (2nd session)	YES	NO
	Lunch—Vegetarian/Non-vegetarian	YES	NO
	Technical Paper Meeting (3rd session)	YES	NO
	Nidhu Bhusan Memorial Lecture	YES	NO
	Entertainments	YES	NO
	Ladies Programme (as per details given in the earlier pages)	YES	NO
Tuesday, February 28, 1967	**Local Projects Visits**		
	No. 1/No. 2/No. 3/No. 4/No. 5	YES	NO
	Lunch—Vegetarian/Non-vegetarian	YES	NO
	Popular Lecture—2.30 to 3.30 P.M.	YES	NO
	Closing Session of the 47th Annual General Meeting	YES	NO

Outstation Tours

I/We desire to join Tour No. .... as a first choice*

Tour No. .... as a second choice

Date................ *Signature* ....

Please retain your choice and strike off the other.

FORTY-SEVENTH ANNUAL CONVENTION
BOMBAY, FEBRUARY 24-28, 1967

ACCEPTANCE FORM FOR LADIES

Original to be sent to :

The Honorary Secretary,
Bombay Centre, The Institution of Engineers (India),
Ilaco House, Sir P. M. Road, Bombay-1.

This form should be filled in by ladies desirous of attending the Annual Convention and participating in the Ladies' Programme and other social functions during the Convention. The form must be attached to and returned along with the Acceptance Form of the delegate whom they accompany.

(Please fill in block letters)

Name ....

Name of member with whom attending
the Convention ....

Address for communication ....

....

Date	I desire to attend	Indicate your requirements	
Friday, February 24, 1967	Coffee Get-together	YES	NO
	Tea	YES	NO
	Sight Seeing	YES	NO
Saturday, February 25, 1967	Inauguration of the 47th Annual General Meeting	YES	NO
	Tea	YES	NO
	Lunch- -Vegetarian/Non-vegetarian	YES	NO
	The Tenth Sir Mokshagundam Visveswaraya Lecture	YES	NO
	At Home	YES	NO
	Conducted shopping	YES	NO
	Entertainment	YES	NO
Sunday, February 26, 1967	Tea	YES	NO
	Lunch—Vegetarian/Non-vegetarian	YES	NO
	Annual Banquet—Vegetarain Non-vegetarian	YES	NO
	Variety entertainments	YES	NO

Monday,	Fashion Show	YES	NO
February 27,	Local Visit to Atomic Energy Establishment	YES	NO
1967	Lunch—Vegetarian Non-vegetarian	YES	NO
	Conducted Shopping—Jasmine Silk Mills	YES	NO
	Conducted Shopping Sunshine Industries	YES	NO
	Entertainments	YES	NO

Tuesday,	**Local Visits**		
February 28,	No. 1/No. 2/No. 3/No. 4/No. 5	YES	NO
1967	Conducted Shopping—Ambica Silk Mills	YES	NO
	Catering Exhibition at The Institute of Catering Technology & Applied Nutrition	YES	NO
	Lunch at above—Vegetarian-Non-vegetarian	YES	NO
	Clossing session of the 47th Annual General Meeting		

Outstation tours

I desire to join Tour No. ....as a first choice

Tour No. ....as a second choice

Date................ *Signature*..............................

FORTY-SEVENTH ANNUAL CONVENTION

BOMBAY, FEBRUARY 24-28, 1967

ACCEPTANCE FORM FOR LADIES

(Duplicate to be retained by the Delegate)

This form should be filled in by ladies desirous of attending the Annual Convention and participating in the Ladies' Programme and other social functions during the Convention. The form must be attached to and returned along with the Acceptance Form of the delegate whom they accompany.

(Please fill in block letters)

Name ....

Name of member with whom attending
the Convention ....

Address for communication ....

....

Date	I desire to attend	Indicate your requirements	
Friday, February 24, 1967	Coffee Get-together	YES	NO
	Tea	YES	NO
	Sight Seeing	YES	NO
Saturday, February 25, 1967	Inauguration of the 47th Annual General Meeting	YES	NO
	Tea	YES	NO
	Lunch—Vegetarian/Non-vegetarian	YES	NO
	The Tenth Sir Mokshagundam Visvesvaraya Lecture	YES	NO
	At Home	YES	NO
	Conducted shopping	YES	NO
	Entertainment	YES	NO
Sunday, February 26, 1967	Tea	YES	NO
	Lunch—Vegetarian/Non-vegetarian	YES	NO
	Annual Banquet—Vegetarian/Non-vegetarian	YES	NO
	Variety entertainments	YES	NO

Monday, February 27, 1967	Fashion Show	YES	NO
	Local Visit to Atomic Energy Establishment	YES	NO
	Lunch—Vegetarian/Non-vegetarian	YES	NO
	Conducted Shopping—Jasmine Silk Mills	YES	NO
	Conducted Shopping—Sunshine Industries	YES	NO
	Entertainments	YES	NO
Tuesday, February 28, 1967	**Local Projects Visits**		
	No. 1/No. 2/No. 3/No. 4/No. 5	YES	NO
	Conducted Shopping—Ambica Silk Mills	YES	NO
	Catering Exhibition at The Institute of Catering Technology and Applied Nutrition	YES	NO
	Lunch at above—Vegetarian/Non-vegetarian	YES	NO
	Clossing session of the 47th Annual General Meeting		

Outstation tours

I desire to join Tour No. ....as a first choice

Tour No. ....as a second choice

Date............ *Signature* ....

Please tear off here and send the Form early to the Secretary at the Headquarters Office in Calcutta to ensure its quick return to you.

THE INSTITUTION OF ENGINEERS (INDIA)

8, Gokhale Road, Calcutta-20

Railway Board Ref. TC II/2135/65 dated New Delhi, November 6, 1966

CERTIFICATE FORM

CONCESSION FOR ALL INDIA BODIES OF CULTURAL EDUCATIONAL AND SOCIAL IMPORTANCE

It is certified that Shri/Shrimati..........................is a person travelling from..........................to.................. ....to attend .... Conference to be held at ....(Place) on .... (date) and is entitled to the concession of return tickets in any class available for one month as indicated below :

Class	On payment of
First class return tickets	Single first class fare
Second class return tickets	Single second class mail fare
Third class return tickets	Single third class mail fare

*(i) He/She is a servant of the Central/State Government/Local Body or a Statutory Authority or a Corporation or a Government Undertaking or a University.

(ii) He/She is not a servant of the Central/State Government/Local Body or a Statutory Authority or a Corporation or a Govt. Undertaking or a University.

(iii) His/Her travelling expenses will not be borne by the Central/State Government, Local Body or a Statutory Authority or a Corporation or a Government Undertaking or a University.

Place............ .. ..

Secretary

Date............ Association/Conference/Institution

OFFICE STAMP OF THE INSTITUTION

* The item not applicable must be struck out by the Secretary.

** I hereby certify that I am an employee of the Central/State Government/Local Body or a Statutory Authority or a Corporation or a Government Undertaking or a University and that I shall not claim mileage allowance from the Central/State Government/Local Body or Statutory Authority or a Corporation or a Government Undertaking or a University for the journey performed on the concessional return ticket.

Place................ Signature..............................

Date................ Designation............... ....

Office address ....

** *Note* : 1. This certificate (must invariably) be filled in by employees of the Central/State Government/Local Body or Statutory Authority or a Corporation or a Government Undertaking or a University.

2. Government servants, etc., whose travelling expenses are borne by the Central/State Government or Local Body or a Statutory Authority or a Corporation or a Government Undertaking or a University either wholly or even partly are not entitled to this concession. Any breach of this rule by the Government servant will render him liable to disciplinary action.

Keep this with you till after the Annual General Meeting, and then return it to the Headquarters.

I availed of the rail concession given by the Railway Board for members of the Institution attending its Annual General Meetings, and travelled on this occasion from.... .. . . to Bombay and back from Bombay to ....

Name of delegate......... ....

Signature. ....

Date . ...

THE BULLETIN

OF

The Institution of Engineers (India)

SECRETARY & EDITOR : Prof. R. N. Banerjee, B.E. (Elec.), M.S. (Mech.) (U.S.A.),
M. Tex. A. (India), M.I.E. (India)

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Vol. 16 JANUARY 1967 No. 5

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AN IMPORTANT ASPECT OF HIGHER CONTROL IN MANAGEMENT

S. R. Chatterjee

Member

Executive Director, Mahindra & Mahindra Ltd., Bombay

With the exception of the United States the conception of management is still vague in many countries, to a varying extent, and until quite recently, even in Europe, it was thought that management calls essentially for leadership, character and shrewdness in business operations. In the United States the rapid development of highly advanced industries made it apparent about a quarter of a century ago that whereas successful management does necessitate leadership, character and shrewdness, these qualities are by no means entirely adequate for what has become a highly professional activity.

In India especially, where adequate management is the key to many of our urgent problems, it is absolutely essential for industrialists as a whole to understand that management calls for professional training experience and is an applied science which must be studied in the same way as engineering or accountancy, etc.

Management topics cover such a wide range, from industrial psychology to operational analysis, that it is sometimes difficult for senior executives to get a firm grasp of any one important aspect of higher control. What is proposed here is confined to management accounting to give a concise explanation of how a typical management accounting system operates in practice.

The senior executives in all well-established commercial/industrial organization exercise higher control in management increasingly through the use of figures which are supplied in statements of accounts. It is, of course, well-known that company operations are based generally on a close and continuous study of the statements and returns which are prepared by the accounts departments. This is no novel feature in the running of business houses in India.

These orthodox statement of accounts and returns are mainly contained in profit and loss statements and in balance sheets, which in well-run firms are made available by the accounts department on a monthly basis. After an industry has reached a certain stage of development, and especially if it is faced with competition, the above orthodox statements and returns are inadequate for the formulation of management policy for several reasons, some of which are:

(i) When presented in normal balancing form the profit and loss statement and balance sheet require a good deal of investigation for the bringing out of facts which may be wanted for management decisions.

(ii) The orthodox statements mainly represent a state of affairs at any given time and naturally do not provide a running record of what is happening in the particular organization concerned. In other words, if a senior executive is sufficiently conscientious he has to, each month, dig out facts and figures from previous statements, if he wishes to know the progress being made by his company and the importance or otherwise of several important operational features. In carrying out this monthly analysis the senior executive is very often liable to overlook many important details, unless these are systematically tabulated for continuous recording and scrutiny.

(iii) These orthodox statements and returns are drawn up by professional accountants in the normal auditing form and cannot very often be interpreted by managing directors and senior executives who have risen to that position from other branches of industry. It is often impossible for a managing director to study accountancy in detail in middle age, when he is under pressure to keep his business running profitably and expanding.

Management accounting is therefore the re-arrangement of information supplied from the above orthodox accounts, and its analysis and diagnosis, all carried out in a manner which makes it feasible for senior executives to conduct daily operations and to formulate policies. From the definition given above it will be understood clearly that management accounting is not a substitute for orthodox statements and returns and in fact the system can only be utilized in concerns which already have well-established accounts, production and sales, etc. procedures. In particular, management accounting is derived from the following orthodox statements and returns, which are normally presented at monthly and Board meetings: (i) P & L statement current; (ii) P & L statement cumulative; (iii) Expenditure details sheets supporting statements; (iv) Balance sheet; and (v) Cash forecast. Perhaps it should also be stated that the profit and loss statement which, the author feels, has in turn to be supported by the monthly manufacturing accounts, trading accounts and appropriation accounts, all presented in the usual balancing form. It will be seen therefore that costing for instance is a standard basic requirement for accurate management accounting, inasmuch as the manufacturing account is derived from costing figures.

Apart from the fact that management accounting cannot be operated without the above orthodox statements and returns, it is emphasized that normal budgeting, on a quarterly, six-monthly or yearly form, and cash generation and distribution estimates are basic for management accounting.

Having discussed the general background of the system, a concrete example of how to re-arrange the information which is supplied from the orthodox statements and returns in management accounting form is given below. In the first place, the profit and loss statement and balance sheet are re-arranged in vertical forms.

In the vertical projection forms the main effect is to re-arrange the information, which is given in balancing form on the corresponding orthodox statement in a manner which is of special value for management purposes. For instance, looking at the re-arranged income and expenditure statement the managing director can see at a glance the components comprising the sales value of production, under heads such as factory on cost, sales overheads, administrative overheads, etc. These main heads are further sub-divided into detailed items. Without re-arrangement in the vertical form it is quite impossible for the managing director to know for instance the proportion of such items as direct labour, indirect material, indirect labour, etc. which make up the total sales value of production.

In the case of the re-arranged balance sheet, the aim is to arrive at what is known as the 'asset variation statement'. The balance sheet for the month concerned, in the re-arranged form is set up side by side with the balance sheet for the last financial year and each item is then examined under two columns, headed 'assets increase' and 'assets decrease'. The total difference in the two balance sheets should correspond with the change in the net worth and the difference found in the net worth represents profits or losses.

The assets variation statement is therefore a method of studying the movement of money in the business.

From the management point of view the above vertically projected records are not sufficient to provide information regarding the trend and progress being made in a business, unless there can be some method of continuous comparison.

It is therefore usual in management accounting to enter the monthly results for the entire financial year on to comparison sheets which give the current, cumulative and moving annual total figures. For each month each item on the vertical statement is given as a percentage of the sales value of production, and similarly against each item there is recorded the budgeted percentage of the sales value of production. From these records therefore the managing director can see at a glance what the current, cumulative and moving annual totals are with regard to the trend and performance against budgets and since management accounting records are presented monthly, at the most within a week after the submission of the orthodox accounts, the executive staff of a company is in a position to take immediate action and to formulate policies.

While the comparison sheets in themselves give complete and exhaustive information it is at times necessary for the management to concentrate on certain 'key figures', which vary with each business or industry.

For instance, a typical set of key figures are as follows:

(i) Sales turnover (current, cumulative and moving annual total).

(ii) Gross profit and percentage of sales value of production (current, cumulative and moving annual total).

(iii) Net profit and percentage of sales value of production (current, cumulative and moving annual total).

(iv) Sales value of production.

(v) Direct labour and percentage of sales value of production (current, cumulative and moving annual total).

(vi) Indirect labour.

(vii) Direct material and percentage of sales value of production (current, cumulative and moving annual total).

(viii) Indirect material.

(ix) Factory expenses and percentage of sales value of production (current, cumulative and moving annual total).

(x) Administrative expenses and percentage of sales value of production (current, cumulative and moving annual total).

(xi) Sales expenses and percentage of sales value of production (current, cumulative and moving annual total).

(xii) Finished goods, work-in-progress, raw material, sundry debtors, sundry creditors and overdraft.

Apart from the above key figures there are certain 'barometers', which indicate the health of the business. These are:

(i) Liquid ratio.

(ii) Current ratio.

(iii) Circulating capital flow speed.

(iv) Productivity indicators.

The above indicators are recorded in the same manner as the key figures which have been mentioned above. The next operation in management accounting is for the key figures, of which examples have been given above, to be plotted monthly in the form of graphs, which set off current, cumulative and moving annual total curves against the budgeted (that is the target) curve in each case.

The interpretation of the above information is fairly obvious, and there are several ingenious systems of arriving at projected results, of which the Du Pont method is an excellent example.

The next standard record in the management accounting system is an analysis which simply states exactly what movement has taken place in each key figure, with reference to the current, cumulative and moving annual total positions. This is a matter mostly of simple arithmetic.

The intricate portion of management accounting comes with the next enclosure, which is a diagnosis of the movements, which have been stated in the analysis. When it comes to establishing why the movement has occurred, this can only be done by a person who has intimate knowledge of the business or the industry concerned. There are no universal criteria for the movements which take place in the key figures of different industries, but it is necessary for one person to be able to diagnose these movements, in terms of the information which has been prepared as discussed in the preceding paragraphs.

There is one particular diagnosis, which is made possible from the assets variation schedules. It is possible to evolve a complete understanding of the movement of funds from the assets variation schedule and to study how funds have been obtained from either owned sources, borrowed sources or from profits and secondly to be able to see whether these funds have been expended on increasing assets, decreasing liabilities or meeting losses. Obviously this illuminating information must be at the managing director's finger-tips every month if he is to know exactly what is going on with regard to his investment and provenance. The above re-arranged vertical forms, analysis, diagnosis plus schedules stating the business and operating positions comprise the management accountant's complete report to his managing director. It is with this complete information that the managing director is able to report to his Board on the operational features of his company and to recommend policies.

Whereas this outline will I hope serve to explain the principles of management accounting I think I should warn all future senior executives that in the normal course of circumstances a good deal of resistance can be expected from average employees, who are unable at first to comprehend the aids which this new form of accounting provide for management. However, it has been my experience that when this resistance is overcome and the system has been worked for a few months the value of it becomes so apparent that there is usually no difficulty in sustaining the new procedures.

There is a mistaken idea, which is often utilized as an excuse for not introducing the new system, that management accounting necessitate the employment of highly qualified additional staff. I should like to emphasise that this is not the case, because management accounting procedures are carried out in standardised form, which can usually be filled in by any intelligent clerk, although the analysis and diagnosis sections are usually the responsibility of one person, that is the management accountant, who is in most cases the personal assistant to the managing director.

The diagnosis section calls for intelligence and understanding of the particular business concerned, as it is on this diagnosis that the managing director bases his records to the Board and formulates his policies, but this does not mean that several persons have to be employed in a separate management accounting department. Actually the work concerned is usually carried out in a day every month, and the returns, graphs, analysis and diagnosis are made available to the managing director within a week of the receipt of the supporting orthodox statements, by one responsible person.

As stated earlier, managment accounting really emerged as a new technique in the United States because of the increasing complexity of the industries in that country, which were operating under conditions of severe competition. A method had to be evolved by which a whole new generation of managing directors, who were not accountants could understand the figures of their business as a whole in such a manner as to be able to take early and effective control action.

Such conditions do not exist in India and it is therefore only the forward looking firms who can be expected to be interested in introducing management accounting, if only in order to disseminate industrial awareness among senior executives. However, such Indian firms as are interested in exporting will be increasingly involved in management accounting, if they wish to face international competition successfully.

THE LARGE DRAINAGE SYSTEMS FOR THE PARIS REGION

H. Polet
Non-member
Chief Engineer, Engineering Department, City of Paris

Introduction

The drainage systems department, which comes under the Water and Drainage Systems Engineering Division, has a twofold duty: (i) to administer the inter-community sewage network within the Seine department on behalf of the entire region; and (ii) to build and to operate the large discharge facilities of a regional character which are provided for in the general drainage scheme for the Paris region. The first of these activities, which is comparable to the work carried out by the Paris Sewage Authority, is not dealt with here. It should be noted that, although it does not include facilities comparable in size to the large Paris mains, this network nevertheless has a total length of some 1,200 km., of which about 200 km. consists of mains, and 1,000 km. of collectors and other inspectable sewers. Mention may also be made of the necessity of keeping a constant watch in the suburbs on the numerous industrial effluents which could be a danger to operatives.

Construction of large outlets for draining the whole of the region towards the Acheres purification station is described in this paper. These facilities, although also intended to transit waste water from the outskirts in non-negligible quantities, are constructed exclusively for the Seine department, subject to the participation of the District Authority of the Paris Region.

General features of the outlets

The layout of the large works in the general drainage scheme is given in Fig. 1, which also shows the progress already made in implementing the scheme.

Considering the size of the streams to be drained off (from 10 to 15 m.^{3} each), and the shallowness of the slopes for the flow under gravity (from 0.15 to 0.35 m. per km.), the section of the large outlets is relatively great; from 3.75 m. diameter for the Sèvres-Achères and Saint-Denis-Achères outlets up to 4 m. for the two branches of the Clichy-Achères outlet.

These works extend on the average to a depth of about 30 m. the minimum depth being only a few metres, mainly near the Seine, and the maximum of 92 m. being reached by the North-East outlet where it passes under the Butte de Menilmontant, near the Port du prè Saint-Gervais.

Geological factors

The types of soil encountered by the shafts and galleries of the outlets cover the whole range of tertiary formations in the Paris basin, penetrating even to the Seronian chalk, and finally emerging in the quaternary alluvium.

They include principally the Auteuil sands, the loams and false loams of the sparnacian stage, the middle and upper coarse limestones topped with marls and soft chalks, the Beauchamp sands, the marls and marly limestones of Saint-Ouen, different gypsum masses, green loams, Brie travertines and Fontainebleau sands.

The main underground layers water the alluviums, then the Beauchamp sands and lastly the marls and soft chalks, and create large difficulties for the execution of the work.

Sinking of shafts

The sinking of the shafts, despite their relatively small size, often represents the trickiest part of the operations. For some of them, the difficulties are such that it is necessary to resort to special methods, costing much in time and money, such as treating the earth or shoring with metal sheet piles used for coffering. For example at shaft 12 of the Saint-Denis-Achères outlet, the soil was treated by injection of synthetic resins, which necessitated special surface installations. In the case of this shaft the problem was to carry out the sinking through the geological layer of Beauchamp sand; all efforts to hold back this layer were unsuccessful. At shaft 24 of the North-East outlet, it was necessary to make use of a wall of sheet piles.

In the case of other shafts it is only by continually fighting with wet and crumbling soil that any sinking progress can be made. Large lateral chambers permit the installation of drainage pumps, ensuring progressive drying out of water-bearing formations.

Construction of the galleries

Methods of constructing subterranean galleries are too numerous to be described in this article, which will be confined merely to those usually applied for the provision of the outlets.

Generally the excavations are done by hand in the sands and with pneumatic equipment in the marls and clays. Explosives are used only in rocky parts, when there is no danger, and every precaution is taken in using them.

One of the following three methods was used, depending on the nature of the soils:

(i) The traditional, so called 'timbered galleries' method, with a full cross-section or divided cross-section, lined with millstone grit masonry;

(ii) The full cross-section method, with a lining of mechanically compacted concrete; and

(iii) The full cross-section method, with a segmented lining.

Traditional methods

The traditional methods, especially the one making use of a divided cross-section, include a certain number of successive phases: providing the drift gallery, doing the cuting, and lastly tunnelling the core. Excavation begins with the drift. The latter is a trapezoidal gallery with a cross-section large enough for the passage of the cars removing the excavated material.

The timbering of the earth includes 'frames', which are solid portals made of logs and forming the principal framework of the gallery and ensuring the safety of the workers. These 'frames', consisting of a capping

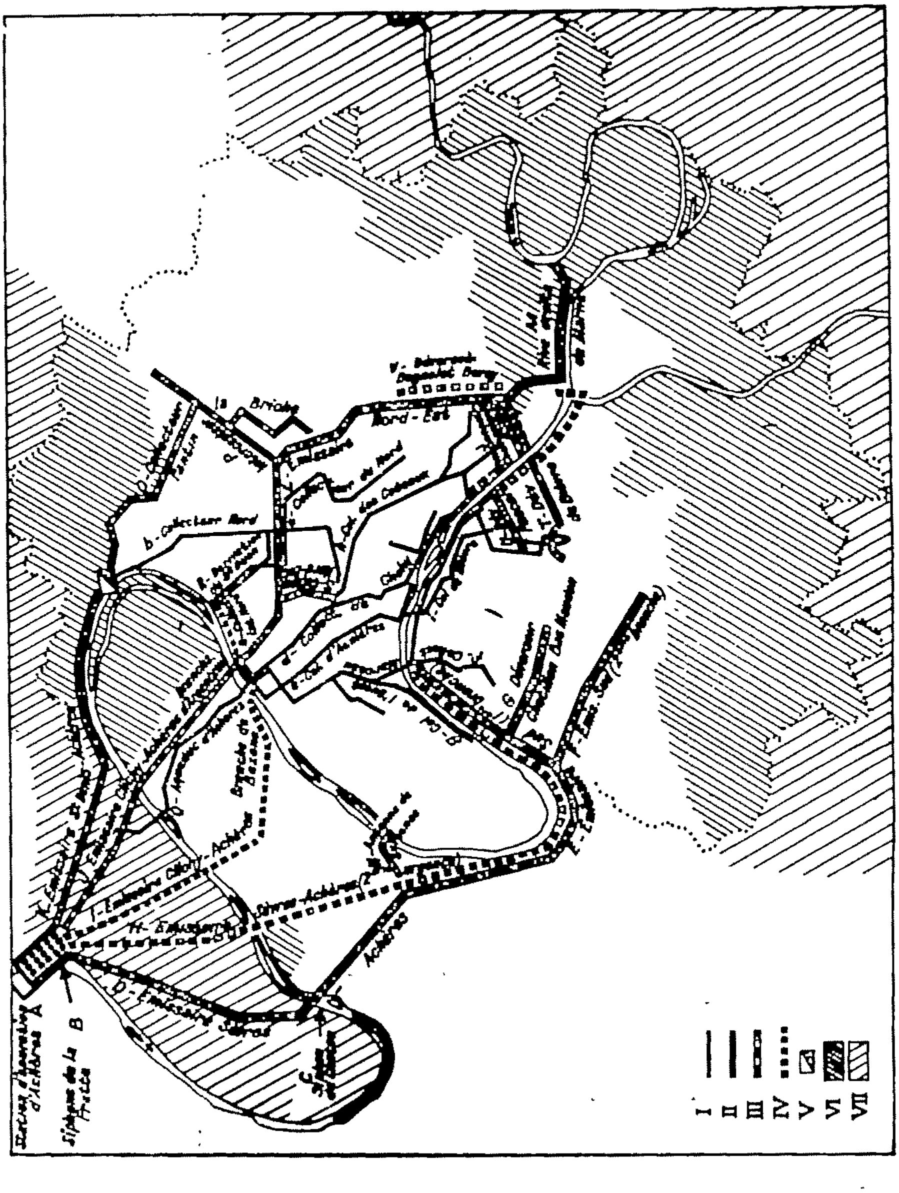

Fig. 1
General drainage scheme for Paris region

Interpretation of notations used in Fig. 1

I. Existing collectors
II. Facilities in the general drainage scheme finished
III. Facilities in the general drainage scheme under way
IV. Facilities in the general drainage scheme planned
V. Desilting plant
VI. Zones equipped for separation
VII. Areas in the Seine-et-Oise department which will possibly be connected to the separating system provided for in the scheme

A. Achères Purification Station
B. Siphons at La Frette
C. Chatou Siphon
D. Sèvres-Achères Outlet
E. Southern Outlet (Branch No 1)
F. Southern Outlet (Branch No 2)
G. Chatillon-Bas-Meudon Spillway
H. Sèvres-Achères Outlet (Standby)
I. Clichy-Achères Outlet (Bezons Branch)
J. Clichy-Achères Outlet (Argenteuil Branch)
K. Saint-Denis-Achères Outlet
L. North-East Outlet
M. Right Bank of River Marno
N. Suresnes Branch Main
O. Pantin La Briche Collector
P. Intercepting Main
Q. Achères Aqueduct
R. Saint-Ouen By-pass Lines
S. North-East Slopes
T. Bièvre Spillway
U. Pascal Spillway
V. Bagnolet Bercy Spillway
a North Lateral Collector
b North Collector
c Northern Collector
d Clichy Collector
e Asnières Collector
f Marceau Collector
g Western Collector
h Coteaux Collector
i Bièvre Collector
j. Vincennes-Charenton

supported by two poles resting on the ground on slabs, are usually 1.60 m. apart, separated by stringers and carefully braced to ensure overall rigidity. Depending on the soil, the lateral walls and the ceiling of the gallery are coffered with a lining of planks, which may be contiguous or not.

The heading is done at the end of the gallery starting from the last frame placed in position; the excavation is carried out in such a way that the soil to the right, to the left and above the men at work is constantly maintained in position.

When the drift has reached a certain length, lateral cutting is begun. This part of the work is done by freeing the soil on either side of the drift, while maintaining the shape of the arch.

Cutting is usually carried out on two contiguous spans of the drift, the sides of the cutting face being suitably timbered as the work proceeds.

The upper half-section of the works is thus cleared entirely.

Shortly after the cutting has been completed, the covering for this half-section is constructed.

This method of cutting with a reduced section is the most commonly used in France. After the arch has been lined, the core, *i.e.*, the lower half-section of the excavation, is cleared away. This work is usually accomplished without difficulty.

The lining used for the outlet in the portions worked by traditional methods consists mainly of millstone grit masonry lined on the inside with a resistant coating of rich mortar.

Reinforced concrete has been used for the lower half-section, however, when the state of the soil gave cause for anxiety as to the future stability of the works.

Mechanically compacted concrete method

This method, especially well adapted to large works of circular profile, requires that the excavation of the gallery be carried out over the whole section and can therefore be applied only in soils offering enough cohesion. Since the lining must be made of concrete which is waterproof throughout, positioned behind a movable metal coffering closely hugging the inner shape of the works, it is moreover indispensable that the entire inner section of the outlet should be cleared completely once the shoring has been removed.

Generally, the soil is supported by metal hoops of varying cross-section, depending on the risk of caving in. These metal hoops can be replaced by prefabricated reinforced concrete elements. The two methods most commonly used for positioning of the hoops are the direct method and the substitution method.

In the direct method, the metal arch element used for the drift gallery is positioned and held either by two binding-pieces embedded into the cutting face, or when working conditions are less favourable, by two temporary props.

The lateral arch elements are then positioned after cutting and their bases are embedded in the soil or sealed in small concrete blocks.

The substitution method makes use of the older construction form of a drift gallery and cuttings. The wooden frames are then duplicated with metal arches. The initial support may be kept in place if necessary until the concrete is laid. In poor soil, the metal arches completely envelop the outlet.

When the work site is open over a certain length, the concrete is laid behind metal coffering. It must be possible to use this expensive metal coffering over and over again. It must be easy to handle so that it can be readily displaced inside the outlet gallery.

Two kinds of coffering are customarily used, the telescopic kind consisting of a number of articulated panels, and coffering made of independent panels supported by metal arches assembled *in situ* underground. The positioning of the first kind is more rapid than that of the second, but it is much more expensive and less adaptable to slight changes in direction of the gallery. The length of the cofferings customarily used varies from 7 to 12 m., enabling the concreting to be done with elements of about 5 to 10 m.

The concrete is always mixed above ground and positioned behind the coffering by pneumatic injectors. Vibrators placed on the coffering ensure good settling of the concrete.

The use of mechanically compacted concrete gives walls that are very compact, leakproof and that have a smooth surface without the need for a coating. As a rule, there is no need to inject a binder. Such a lining is much more economical than millstone grit masonry; its homogeneity and its strength mean that the thickness can be reduced to 30 cm. on the average for outlets of normal diameter, as against 45 to 50 cm. for millstone grit masonry.

Utilization of prefabricated segments

In some zones of the geological formation of the Beauchamp sands, which are particularly prone to caving in, and where the foregoing methods come up against enormous difficulties, it became necessary to develop a special method.

The originality of this new method resides in the way the excavation is done, coupled with the use of shaft linings consisting of prefabricated reinforced concrete segments.

The principal shaft lining or 'primary lining' is formed of successive rings 0.60 m. long consisting of prefabricated segments of reinforced concrete, bolted to one another and to the adjacent rings.

The tunnelling is done over the full cross-section, to match the outer shape. In very poor soil, each excavation involves tunnelling 0.60 m., *i.e.*, over the length of one ring. If the soil is better, this length is increased to 1.20 m., enabling two rings to be fitted.

The excavation is done in two stages, the upper half-section and then the lower half-section.

The upper cutting face is then lined with vertical contiguous bastings, and their upper ends support the butt-ends of the lateral shielding planks. The other ends of these planks rest on the last ring of the segments through the medium of a packing-piece. One or more transverse pieces in squared wood bolted at the back to a ring are used to retain the vertical shielding in position. The lower cutting face is set back from the upper face to allow planks to be slipped in vertically. The bastings and shielding planks are recovered and used again a certain number of times.

In principle, the stream water is collected either in a drain which takes it to a normal sump pit located some way back, or directly at the cutting face in a smaller sump pit. In both cases the water is evacuated by pumping.

In the Beauchamp sands which, although full of water, are partially impermeable because of their very fine grain size (quicksand) and exude little during the short time needed to carry out the excavation (usually nine hours) and the positioning and injection of a ring (three hours), the water is taken off directly at the cutting face.

The reinforced concrete segments which constitute the primary lining are more massive replicas of the familiar cast-iron or steel segments used in the past for crossing water-bearing running ground in the shelter of a shield. The segments utilized for the outlet offer the same advantages as metal segments, but they are less expensive. Each ring is formed of six elements and a thin keystone which is needed to position the last segment.

For a structure with an inner diameter of 3.75 m., each segment weighs about 280 kg. It consists of a cylinder element lightened by means of four recesses shaped like right pyramid frustrums; its overall thickness is 0.15 m. and the thickness at the bottom of the recesses is 0.05 m. Its four marginal ribs are drilled with holes for the assembly bolts.

The segments incorporate an electrically welded reinforcement. They are constructed at the factory on a vibrating table and are used on the work site only after having been dried for three weeks.

The positioning of a ring necessitates the use of 36 bolts, of which 12 are used for interconnecting the six segments, and 24 are for joining them to the preceding ring.

To prevent abnormal stressing of the lining which could cause fractures, a certain amount of elasticity is provided by interposing a 4 mm. thick plastic sheet of tarred and surfaced jute between two successive segments of the same ring, and by fitting a 14-mm. single-strand tarred cord between two consecutive rings.

These measures contribute also to the watertight qualities of the work. It is necessary however to make watertightness absolute, by blocking up all the voids which may exist behind the ring by injection of cement mortar which is introduced through a 50-mm. hole left in each segment, and by filling in each joint between the segment rings with a paste made of asbestos and a powdered hydraulic binding agent.

The segments are brought to the work site on trolleys. They are unloaded by means of a cable operated by a compressed air driven winch and running over a pulley fixed to the top of a ring already in position.

The lower segments are first placed on carefully adjusted checks, then bolted to one another and to the preceding ring. The side segments follow symmetrically. To place the upper segments, it is necessary to lay a floor supported at the cutting-face end by the shoring cross-piece and at the other end by another piece wedged into a preceding ring. The last two segments are placed on the floor by the winch and then positioned (as is the keystone) by the workmen who tilt them and place them against the side segments. As soon as a ring is positioned, the voids remaining in front between the earth, the shielding planks and the ring are stopped up and the open spaces around the lining are filled in by injection of a thick cement mortar grout, starting from the bottom. The proportions of cement and the silicious sand are determined according to the behaviour of the earth and the volume of the voids to be filled.

This method of consolidating each ring by injection enables the lining to adhere to the earth and to effectively withstand the pressures which would be developed if the earth were to loosen up. This first injection pass is supplemented later by a second pass at greater pressure. The internal profile of the outlet is finally obtained by a lining of mechanically compacted concrete which fills the recesses in the segments and presents a uniform surface comparable with that obtained from a coating smoothed with a trowel.

This lining of chipping-concrete, which is poured behind a metal coffering and compacted mechanically, is up to 0.10 m. thick in front of the segment ribs and up to 0.20 m. thick in the recesses.

Work in the Beauchamp sands formations however remains very hazardous, as the following example will show. One Sunday when no work was being done at a work site, the pressure of the earth caused a shielding plank to slide a little at the cutting face. Through the orifice thus formed, although it was very small, 500 m.^{3} of sand and water entered the gallery. The tunnelling at this point was only resumed six months later after the voids had been filled and the earth had been solidified by injection of synthetic resins.

The shield method

One of the advantages of the segment method over the traditional methods is that, from the first stage of the work, it views a gallery completely lined with resistant elements capable of withstanding the pressure of the earth. The cutting face however remains the weak point in this method.

Recently, a method using special shields was tried, also in the Beauchamp sands, on two work sites of the Saint-Denis-Achères outlet. The shield method consists in general in advancing underground within the shelter of a metal cylinder or shield provided at the front with a cutting edge and penetrating into the earth under the pressure of hydraulic jacks. The lining is positioned within the shelter of the rear portion or tail of the shield.

This method has often been used in the past; it has been found necessary for numerous under-river crossings. Nowadays shields are still used. Their use is justified in homogeneous terrain (or at least terrain without large hard banks), where the poor condition of the soil makes traditional methods more difficult. Employed jointly with compressed air, shields have often enabled difficult situations to be overcome.

The shields used on the Saint Denis-Achères outlet possessed the following additional improvements: double shielding of the cutting face permitting the evacuation of the excavated material without risk of decompression of the earth ; automatic control of direction ; and the possibility of lining the gallery by means of segments or by mechanically compacted concrete.

The external diameter of the shields was 4.35 m. They penetrated into the sands by successive passes of 0.75 m. under the thrust of 16 jacks of 110 tons each, developing a total thrust of 1,760 tons. The double shielding system at the front of the device consisted of hinged flaps which could move in vertical slideways as the work advanced, and sliding doors which jointly with these flaps formed a lock.

The tunnelling was done with the flaps open and the sliding doors closed by the push of the earth left in place as the shield penetrated. The flaps, operated by jacks, were then closed at the front. Lastly the sliding doors were opened for the earth cut by the flaps to be removed. These machines have enabled work to be carried out on extremely difficult terrain where all the usual methods were shown to be impracticable or very dangerous. Of course, the positioning of these shields inside the gallery necessitated the construction of underground chambers large enough to permit assembling of the component parts lowered through previously-sunk access shafts.

Mechanized excavation in soil with good cohesion

Firms called upon to work on underground sites are tending more and more to use mechanical earthmoving machinery, thus dispensing with expensive and scarce manpower. On a site recently worked on the Saint-Denis-Acheres outlet, the equipment used consisted of a tool-bearing portal movable on rails, bearing two mobile arms equipped with pick hammers, each capable of sweeping across half the excavated surface, whilst a third arm carrying a perforator was able to position itself at any point on the cutting face.

A self-loader enabled the excavated material to be taken up between the legs of the portal and carried to a skip for transport to the surface. This skip was installed on a gallery access shaft.

With such equipment, daily progress was three times as great as with purely manual excavation.

Finally, our last invitation to tender produced proposals utilizing more complex machinery permitting fully mechanized tunnelling, like the machines used on the regional underground railway between the Etoile and the Seine, but the amortization of the machines proved too costly for it to be possible to give preference to such methods over outlet sections about three kilometres long.

Some special works connected with the outlet network

Two spillway shafts for the North-East outlet have been sunk, based on a model not commonly used for works of this size. The problem at this juncture was to bring the water from the sewers and surface collectors to the level of the outlet, i.e., some 30 m. lower than normal. The flow rate is first raised to 5 m. per sec., down a steeply sloping input conduit.

The water is then admitted into the spillway shaft, consisting of a bowl-shaped upper chamber, the shaft itself which has an inner diameter of 2.40

m. and the walls of which are lined with spiral reinforcements, and a lower receiving chamber.

The upper chamber distributes the water over the vertical wall of the bowl, before introduction into the shaft. The water streams, guided by the helices and applied against the wall by centrifugal force, thus reach the lower part of the shaft without any further increase in speed, and free from turbulence. After being collected in the lower chamber, the water is then injected into the outlet in a way designed not to deteriorate the works. One of the two shafts in question is fitted with a stairway giving access to the outlet, located exactly on the axis of the spillway shaft.

Some figures

The outlets for the general drainage network encounter numerous twists and turns as the Seine meanders through the Paris basin, and therefore have to cross the river *via* under-river siphons which have an inner diameter of 3.25 m. At this juncture three siphons have been built, three are under construction and work will begin very shortly on two more.

It would be tedious to describe the methods used for the first two works. It will suffice to give a broad outline of the construction method used for the third siphon, located at La Frette on the Saint-Denis-Achères outlet. This method is now being used, with some slight modifications, for the joint construction of three siphons, which bring to five the number of works crossing the river between La-Frette-sur-Seine and Achères.

The method used consists in laying, in a berth dredged in advance across the river bed, sections of the work floated along to a point immediately above their ultimate locations. The lengths of the different sections were respectively 50, 82, 36 and 29m. for the siphon on the Saint-Denis-Achèras outlet, the longest section being equal to the width of the navigable part of the Seine. Each section was composed of 5 m. long cylindrical elements made of concrete, heavily reinforced transversely. These different elements were built on the river bank and then assembled by prestressing cables passing through sheaths inside the concrete and tensed by special devices at the ends of the sections. Such a method requires great precision of assembly. The sheath of each element must be exactly opposite that of the next element, since any tendency to uncouple would prevent the cable from being tensed.

The prestressing cables had an outer diameter of 32.4 mm. There were twenty-eight of them, giving a total cable length of 5,600 m. for the entire siphon. Each cable consisted of seven strands of seven 3.6 mm. diameter wires, i.e. a total of 274 km. of high tensile steel wire.

Under the 65 tons of prestressing traction applied to the cables, the latter underwent an elastic elongation of about 1%, or 85 cm. in the case of the 82 m. long siphon section.

The total prestressing force thus applied was more than 1,800 tons. No splitting of the pipes was noted either during handling, or following the uneven settling of the foundation.

After being constructed on the bank, each section was equipped with leakproof internal walls to enable it to float. The handling of such large units, the lightest of which weighed 200 tons and the heaviest 700 tons, necessitated the building of launching ramps and posed many problems.

After being placed in the water, each section was towed by two sets of two-pontoons to a point just above the prepared berth in the river bed, gradually submerged by the introduction of water ballast and positioned exactly on the cradles designed to receive it.

The joints between individual sections are elastic to permit expansion or contraction due to temperature fluctuations and the like. These joints consist of double cradles in red copper, *viz.*, a cradle internal to the siphon and an external cradle securely fixed to the adjacent sections, using rubber gaskets in between. The outer cradle is retained in addition by two steel hoops.

The joint is protected externally by a concrete ring executed under water, and internally by a reinforced lining. The installations upflow of the siphon include a gallery section acting as the siphon head and forming an extension of the outlet, and a gallery for discharge into the Seine.

In addition to the various valves and truss weirs used to operate the system, the head gallery includes a chamber to permit insertion of a special cleaning ball, and a movable spillway sill to enable the flow to be divided as required between the siphon and the discharge gallery. The downflow installations comprise only a chamber for picking up the cleaning ball.

The latter, which measures 2.92 m. in diameter, is specially designed for cleaning works of this size. It is in the form of a sheet-steel envelope and is ballasted initially with a given volume of water. It is equipped internally with a compressed air device which, by means of a timed relief valve, enables an appropriate quantity of water to be expelled to obtain a variable density as the work proceeds. The density of the ball is slightly greater than unity at launch to facilitate barrelling into the siphon. The compressed air system then lowers the figure to about 0.95, enabling the ball to operate normally inside the works and to rise up the ascending branch of the siphon, pushing before it in the process the mass of sand resulting from the cleaning operation.

The Sevres-Acheres outlet is 18,800 m. long, with an inner diameter of 3.75 m. It crosses the Seine twice, at the Chatou siphon and at the La Frette siphon.

The South outlet (No. 1 Branch) is 8,600 m. long with a diameter varying between 3.05 m. and 3.15 m. The South outlet (No. 2 Branch) is 7,100 m. long with a diameter of 2.75 m. The North-East outlet is 17,000 m. long; its diameter is 2.80 m. in the upflow section and increases to 3.90 m. in the downflow section.

The collector on the right bank of the Marne is 4,150 mfl long; it is of an ovoid section with dimensions of 2.40 m. × 1.75 m.

The Saint-Denis-Achères outlet, recently completed(is 12,000 m. long with a diameter of 3.75 m. It crosses the Seine at the La Frette siphon.

The Clichy-Achères outlet (Argenteuil Branch) will be 11,200 m. long with a diameter of 4 m. It will cross the Seine at three points, *via* the Clichy, Argenteuil and La Frette siphons. These works are now under construction.

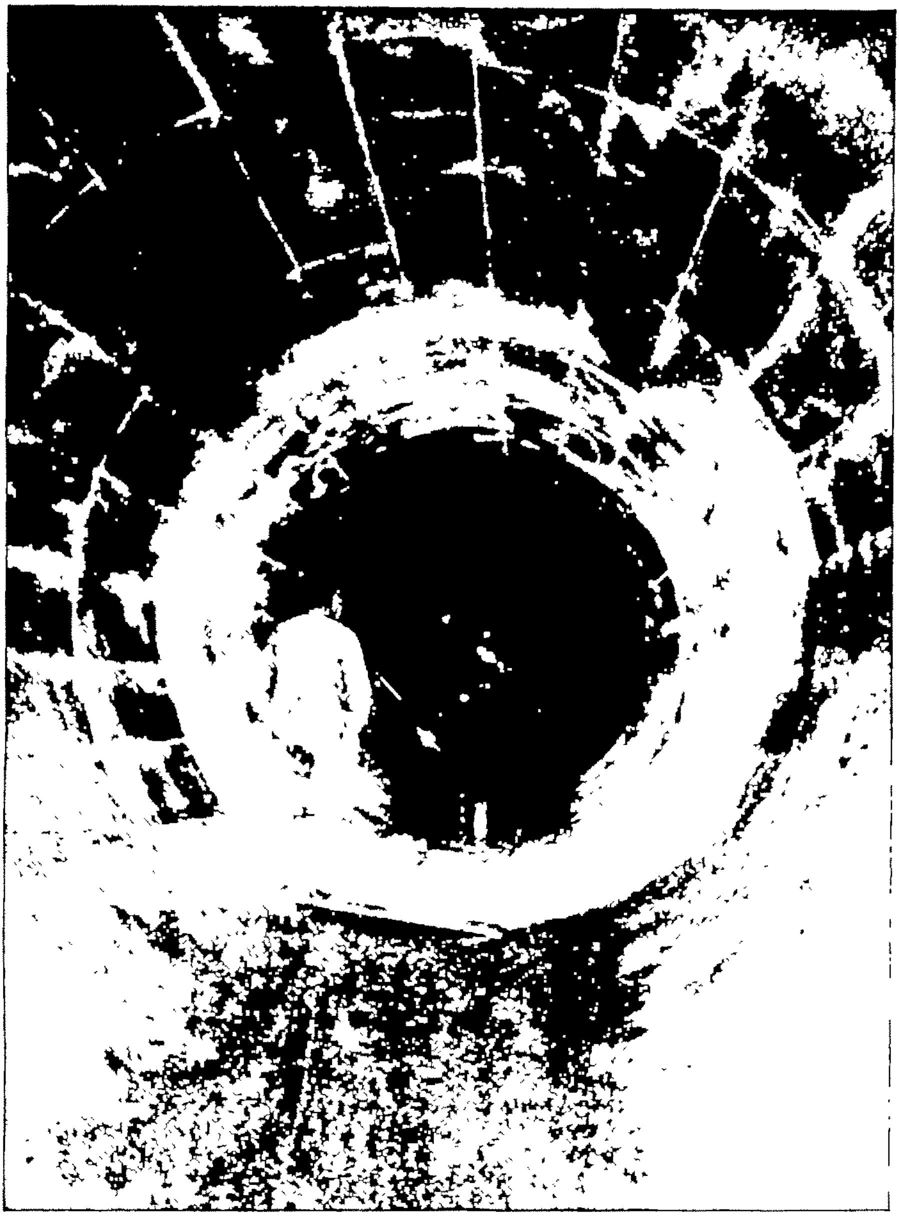

Fig. 15

A view of the underground sewage main in Paris region

REPORT OF THE PANEL ON STATISTICAL TECHNIQUES IN MANAGEMENT

Brig. M. K. Rao

Member

Convenor, Panel on Statistical Techniques in Management

To consider in what ways we can develop our future programmes, based on the successes of the Seminars on 'Statistical Techniques in Modern Management' held at various centres, brief questionnaires were sent to the 70 participants in these Seminars at different centres. Replies were received from 25 of them and they are most encouraging in respect of applications of these techniques and also of suggestions for the future. The analysis of these replies are made and the interim results are appended in the form of a statistical presentation. The Appendix gives the questionnaire and the diagrams.

The applications of S.Q.C., Acceptance Sampling, P.E.R.T./C.P.M., and linear programming are the most numerous and justify the time we devote to these topics. Some thinking in basic mathematics and statistics—at a very elementary level—is incorporated in the Seminars, and needs constant evaluation and review to keep pace with new developments in the management field.

We are glad that the training seminars conducted on the suggestion and advice of the panel on Statistical Techniques in Modern Management by (S.T.I.M.M.) have been great successes. The Panel itself was set up on the success of a first Seminar conducted at Hyderabad in December, 1964. The second Seminar was held at Poona (August 2-13, 1965) and concluded on a very successful note. There were such Seminars at Madras (November 1965), New Delhi (January 1966), and Bombay (August 1966).

The object of these Seminars is to provide an understanding of the new techniques of management (like linear programming P.E.R.T./C.P.M., S.Q.C. and so on) to practising managers, in harness now, who may function in increasingly higher responsibilities in the next 20 to 30 years to come. We emphasize the 'learning' aspect by managers themselves even though adequate instruction is provided in lectures and practical classes; hence the word 'Seminar' has been deliberately chosen for this training programme. Also we focus attention on the basis and foundation of scientific thinking, behind the development of these techniques, that is the reason why we have preferred to call them 'Statistical Techniques in Modern Management' (S.T.I.M.M.). These S.T.I.M.M Seminars provide the tools of management to those managers who can receive them and understand their use. With a proper appreciation of the environment, it is felt that the managers can develop the strategies and tactics (policies and execution) suited to our country. There are already quite a few electronic computers in India, and the number is likely to increase in the future. The success of these S.T.I.M.M. Seminars and the further requests from other Centres made us look at the prospects for the future with a little more ambition.

The Panel on S.T.I.M.M. is suggesting the up of a Management and Consultancy Cell in the Institution of Engineers (India). This would not be duplicating the efforts made elsewhere. On the contrary, we hope to be complementary to those efforts and cooperate in evolving training methods and procedures which would help an increasing number of engineers now to function more effectively in the management tasks to which they are being called by the nation and the technology. It would be a responsibility of a professional body like The Institution of Engineers (India), to meet this challenge to equip the engineer-managers called on to do the management jobs; they have to function in the modern environment as modern managers now.

We do think that efforts made in this direction by The Institution of Engineers (India) will receive the cooperation and will be welcomed by many institutions, including the universities, as fulfilling a vital need. At any rate, the Management and Consultancy Cell will be able to assess the situation and suggest to The Institution of Enflineers (India) in what directions we can proceed; in the immediate future to fill the need for Engineer-Managers in our country.

To start with, we find that for our country, it may be better to proceed on the following lines:

(i) Examine the tools and techniques evolved in the West and know what they are with a clear grasp of the basis;

(ii) Study the environment (technological, political, social and economical) in which we are placed;

(iii) Analyse the job of management and see how best this can be done—with suggestions for changes in environment where these are feasible and advantageous.

If such a Division is set up, provisionally for a year, with a budget of Rs. 6,000 we may reap valuable benefits; and the position can be reviewed before the end of the year to see the benefits and plan further progress.

The budget

The details of the proposed budget are given in the table below:

Details	Amount
1. Honorary Director (Prof. S. K. Ekambaram)	Honorary basis
2. Research Associate (Part-time) (Preferably from a University or College member of Staff) Honorarium	Rs. 1,800.00
3. Office expenses Typist, peon, stationery, etc.	Rs. 3,600.00
4. Contingencies Travelling, conveyance and miscellaneous	Rs. 600.00
Total	Rs. 6,000.00

Prof. S. K. Ekambaram has agreed to function as Honorary Director of the Division for a period of one year. His travel and conveyance expenses need only be paid out of this budget.

If the Institution of Engineers (India) approves of this budget, the Management and Consultancy Cell can be set up (as a nucleus) with effect from January 1, 1967, to December 1967 in the first instance.

Appendix

Questionnaire

1. Have you had any occasion to be influenced by or use any of the techniques listed below:
   - (i) PERT/CPM
   - (ii) Linear Programming
   - (iii) Queuing Theory
   - (iv) Monte Carlo Simulation
   - (v) S.Q.C.
   - (vi) Acceptance Sampling
   - (vii) Statistical approach to Risks and Pay Off

   Give brief details, if necessary, on separate sheets.
2. Would some additional *knowledge of environment* be of use to you in adapting these techniques for use in India? State which or all of these environments would be of interest in your decision making as a manager:
   - (i) Economic environment (includes business)
   - (ii) Political environment
   - (iii) Social environment
   - (iv) Technological environment
   - (v) Human environment
     (This means knowledge of human behaviours—individually and collectively)
3. A management problem may be considered as a purpose in a situation.

   What suggestions, if any, you would consider important in developing Management Methods and Practices, along with Policies and Principles siuted to our country? Give only two or three suggestions which you consider *most important*. If you have NO suggestions, kindly say so and reply to me immediately, using the addressed and stamped envelope enclosed.

Prof. S. K. Ekambaram
B-24 Shastrinagar East,
Adyar, Madras-20

The following suggestions were made:

1. Management Research and Consultancy Division is an excellent idea.

2. A Body of Management Consultants should be organized at various Centres along with groups of specialists in management techniques in each enterprise.
3. Seminars must be residential at big manufacturing concerns to be followed by actual case studies and rigorous work sessions.
4. Short Seminars for top managers may be arranged.
5. Prizes should be introduced for the best application of S.T.I.M.M. methods.
6. Management trainee should be intensified and expanded to attain self-sufficiency in our country.
7. Psychologists with statistical background may be included in the management and the behaviour of the labourers should be analyzed with the psychological background.
8. Clear and steady industrial policies should be followed.
9. Thinking should be based on Indian conditions taking into consideration the limitations of conditions in the 'Sales Market'.
10. Managers should strive to attain the objective of the Company by following well laid methods and policies and there should be more objective approach to any problem based on quantitative facts.
11. Managers should be technical persons with knowledge in Cost Accounting and Accountancy and they should have authority to implement their decisions.
12. As a principle, more quality goods must be manufactured to control the prices and the hoarding and black-marketing.

The diagrams illustrating the analysis of the data collected so far are given overleaf.

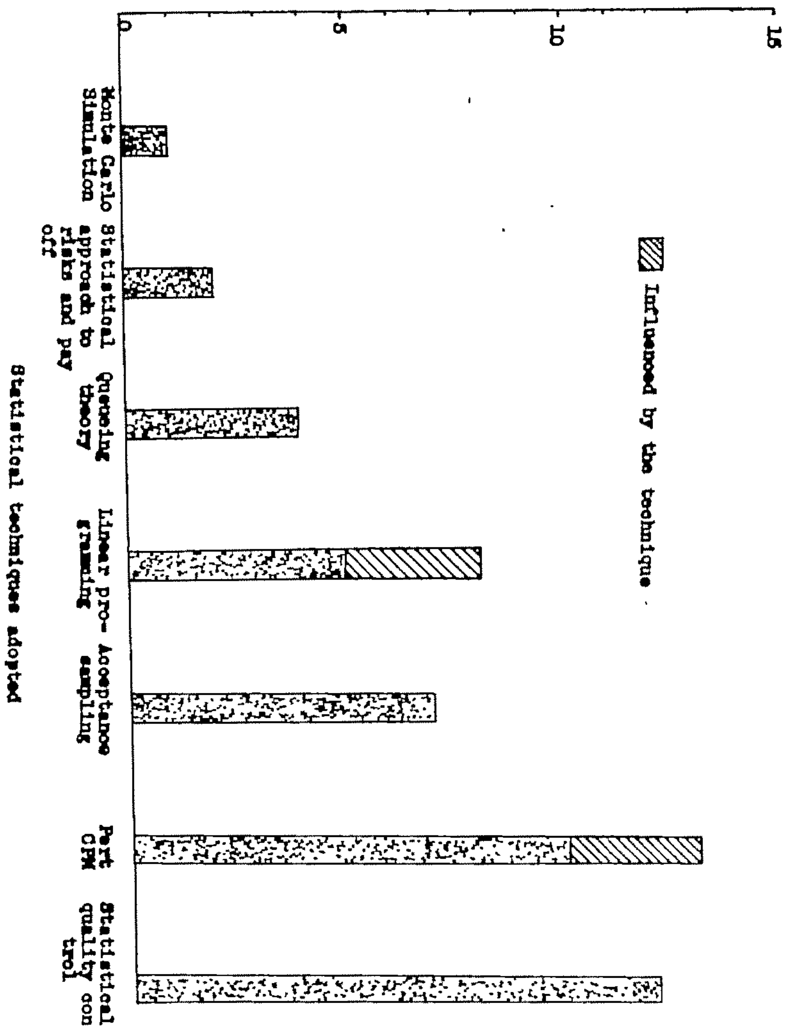
0
5
10
15
▨ Influenced by the technique
Monte Carlo simulation
Statistical approach to risks and pay off
Queueing theory
Linear programming
Acceptance sampling
Pert CPM
Statistical quality control
Statistical techniques adopted

Fig. 1

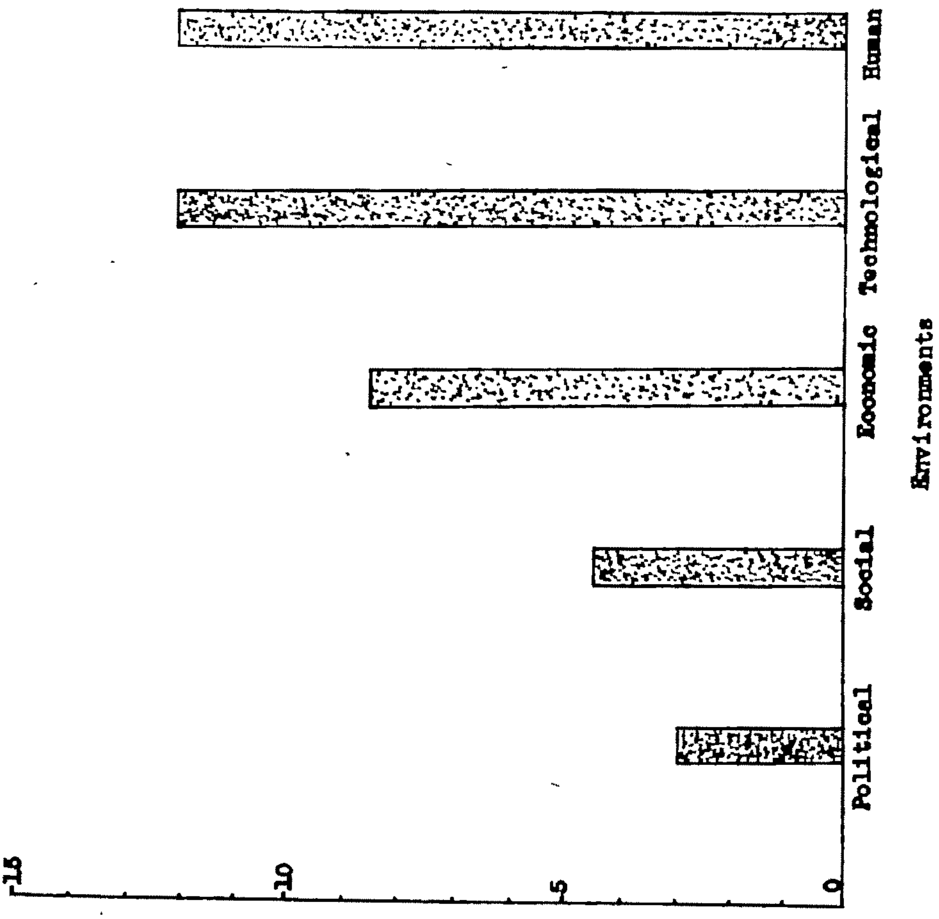
0
5
10
15
Political
Social
Economic
Technological
Human
Environments

Fig. 2

Contemporary World Engineering Project Series—33

Members are invited to contribute to this Series special articles featuring major engineering projects with which they have been associated in any manner. Articles should be preferably accompanied by photographs and illustrative sketches.

THE LITANI RIVER SCHEME IN THE LEBANON*

M. Janod

Non-member

Deputy Controller-General for Equipment, Electricite de France

1. General

Average rainfall in the Lebanon is 800 mm. per year and exceeds 1,500 mm. in certain mountain regions. However, in contrast to what occurs in temperate regions with the same rainfall, this is very unevenly distributed time-wise and mostly concentrated in a small number of short periods of violent rainstorms between December and March. For the remaining period, almost complete drought prevails. Agricultural development of the country calls for irrigation that can only be carried into effect on a wide scale provided the winter rains be stored for use during the dry session. Because of this, the attention of those prospecting in the field has long since been attracted to the Litani River which is the only large river in the Lebanon, since as this river carries about 750 million m.^{3} of water every year to the sea, it offers major prospects for irrigation and the generation of electric power.

After many contacts abroad with bodies capable of solving its serious problems, the National Office for the Litani River turned to Electricite de France (E.D.F.), who had considerable experience in piercing difficult tunnels. In December 1960, E.D.F. agreed to send an exploration team who, after examining every aspect of the problem, geological, technical and economic, concluded that provided a certain number of precautions be taken and modifications made, the work could be continued. In April 1961, a mission of engineers from the Equipment Directorate of Electricite de France was set up in Beirut to direct the work.

2. Major features of the Litani harnessing scheme

The Litani harnessing scheme has many purposes, the main ones being the generation of hydro power and the development of irrigation schemes in the Lebanon. However, considerable problems encountered when implementing the scheme led to delay in the irrigation programmes and these will only start in 1966.

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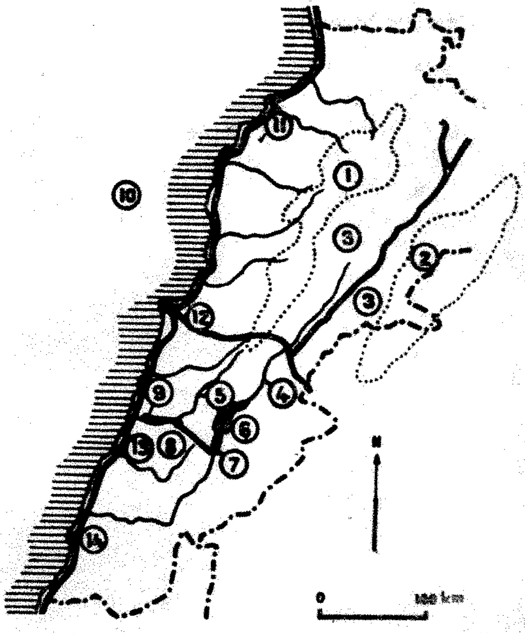
* Compiled from an article published in *French Technical Bulletin*, no. 4, 1966, circulated by the Trade Commissioner for France in Calcutta.

The Albert Naccache dam on the Litani is the keystone of the scheme, enabling 220 million m.^{3} of the winter spates of the river to be stored, and made available during the dry season. This dam was built near the village of Karaoun at the lower end of the La Bekaa plain. It retains the water at a maximum elevation of R.L. 858 and floods about 3,000 acres of land.

The waters stored are turbined in an initial powerhouse 7 km. downstream at Markabi on the Litani. There is a 200-m. head. Installed capacity of the Abd-el-Al powerhouse is 21.5 MVA.

The waters of the Litani next cross the Lebanon mountain chain, through a tunnel of 17 km. length which leads them into the valley of another coastal river, the Bizri, at the Paul Arcache power station at Awali at an altitude of 226 m., after a drop of 400 m. This power station has a capacity of 92 MVA and is capable of expansion up to 138 MVA.



1 - *Lebanese mountain chain*
2 - *Anti-Lebanese mountain chain*
3 - *La Bekaa plain*
4 - *Litani river*
5 - *Awali river*
6 - *Karaoun dam*
7 - *Markabi hydro power scheme (completed)*
8 - *Awali hydro power scheme (under construction)*
9 - *Joun hydro power scheme (under construction)*
10 - *Mediterranean Sea*
11 - *Tripoli*
12 - *Beirut*
13 - *Saida*
14 - *Tyre*

Map of the Lebanon

At downstream, the waters from the Rivers Litani and Bizri are recovered in a water intake and are turbined in the Joun power station on the Bizri at an elevation of 33, after going through a 7-km. tunnel. The water head is about 90 m. and the installed capacity of the generator will be 50 MVA.

The total electric output of the Litani and Bizri scheme will, therefore, be 163 MVA when the structures are completed and could be raised to 209 MVA by reinforcing Awali. The output capacity of the scheme in terms of energy capable of being generated in an average year will be about 700 GWh of which 120 GWh from Markabi, 400 from Awali and 180 GWh from Joun tower houses.

These output capacity values make no allowance for the irrigation schemes and as these develop, the electrical output capacity must be expected to decrease, to the benefit of the agricultural schemes. Studies have shown that there will still be a contribution to the Lebanese electricity network during peak demand periods with the power stations on full output, even when the irrigation schemes come to the final stage.

The power stations are connected to the Lebanese electrical network *via* a principal 70-kV line linking Makabi, Awali and Beirut, doubled up between Awali and the capital. A 70-kV line links Joun to the Awali sub-station and several 70-kV or 15-kV distribution lines connect the power stations to various user points.

The Litani River harnessing scheme in the Lebanon

Above : Karaoun dam

3. The Albert Naccache dam at Karaoun

Owing to its geology, there are few dam sites in the Lebanon, and the Karaoun site was selected after many surveys despite its drawbacks. The most serious of these is the fact that part of the storage floods cracked calcareous and sometimes karstic ground. Despite detailed geological investigations, one could not be entirely sure before actual proof that this ground would be sufficiently tight to withhold a storage volume some 60 m. high. Moreover, the position of the dam proper is a sill rather than a gorge and the dam structure is extremely long—over a kilometre. Nor is the foundation terrain of perfect quality, consisting of alternate layers of limestone and marls that are sometimes clayey.

It was considered desirable to plan a structure which could be built in several stages, so as to be in a position to check the tightness at each stage. There was therefore some hesitation before the choice of differing solutions and after starting the work on a multiple arch projected, interrupted by the August 1959 catastrophe in the Awali tunnel, Electricité de France was in a position to take new stock of the situation and it was then decided to build a rockfilled dam with reinforced concrete sealing upstream, with the following dimensions:

Length ...	1,100 m.
Height ...	60 m.
Materials employed ...	2 million m.^{3}
Area of watertight facing ...	47,000 m.^{2}
Crest elevation of spillway (with normal storage volume) ...	858
Highest water level ...	860.50
Crest level ...	862
Upstream batter ...	About 1.35
Downstream batter varying from top to bottom ...	1.2 to 1
Thickness of reinforced concrete facing	30 to 50 cm.
Storage volume ...	220 m.^{3}
Area inundated ...	3,000 acres

The rockfill was taken from a limestone quarry about 1.5 km. from the structure. It was placed in layers of about 10 m. and compacted by watering with a powerful jet of water as it was tipped off the haulage equipment. For a thickness of about 5 m. near the upstream facing, rockfill laid in rows was used to reinforce the slope, while the downstream facing lay at the natural slope of the watered material. The rockfill laid in rows was covered with a layer of lean concrete and then, after an intermediate layer of bituminous felt, the reinforced concrete sealing slabs of 14 m. × 12 m. were laid. Continuity of tightness between slabs was ensured by inserting rubber seals.

Where it contacted the rock, the facing rested against a concrete cut-off trench anchored in the foundation rock. In the central section of the dam, this anchorage encloses a 3.1 m. diameter gallery enabling the watertight diaphragm to be built deep down, thanks to a grouting curtain, at the same time as the external work was being carried on, and enabling it to be finished even after the structure was partially filled.

This type of structure is well suited to the geological nature of the foundation rock, since it is capable of withstanding settlements and their unevenesses between one zone and another. Moreover, it is the perfect solution to the problem of construction in stages.

The work started in September 1961, and an initial fill to elevation 818 was possible in the first stage, which only called for 80,000 m.^{3} of rockfill. This test enabled the Markabi power station, which was nearing completion, to be commissioned. In the following stage, the storage volume was raised to elevation 834 and by autumn 1962, the first encouraging results concerning the tightness of the retaining bowl were obtained and the structure was continued. Towards the end of the winter of 1963, the dam was up to elevation 842 and the storage volume elevation 838. The rockfill volume was 500,000 m.^{3} At the same time, the watertight diaphragm was being completed from the foot gallery.

In view of the good results achieved, the National Office for the Litani River decided to super-elevate the structure to obtain a normal storage level of 858. This operation was carried out in two stages. At the end of 1964 the dam had reached elevation 851, and during 1965, after having been filled to elevation 850 in the spring, the structure was completed and is now giving normal service, pending complete filling during the winter of 1965-66.

This succession of partial commissionings raised a delicate problem concerning flood discharge during the work. Because of this, the final spillway was designed as an external tower submerged in the storage volume with a passage at its foot to a discharge gallery. This tunnel was first used as a temporary diversion, and then at each stage the tower was built up to the level required.

The observations made at the various filling levels showed that the seepages from the retaining hollow were negligible and this was obtained by a good quality of watertight diaphragm built by Compagnie Francaise SIF (Bachy). This diaphragm called for 91 km. of borings and the grouting of 17,000 tons of cement and 3,500 tons of clay and sand.

The storage volume can be emptied by two parallel lined galleries pierced beneath the left bank spur at about elevation 800. Each of their downstream ends is equipped with a guard gate of the butterfly type and a 1.85 m. hollow jet regulating valve. The whole is capable of a maximum discharge rate of 140 m.^{3} per sec. Breach pipes connected upstream were provided for connecting the pumping sets which are subsequently to be installed to supply the Bekaa irrigating channels.

4. The Markabi Falls and the Abd-el-Al power station

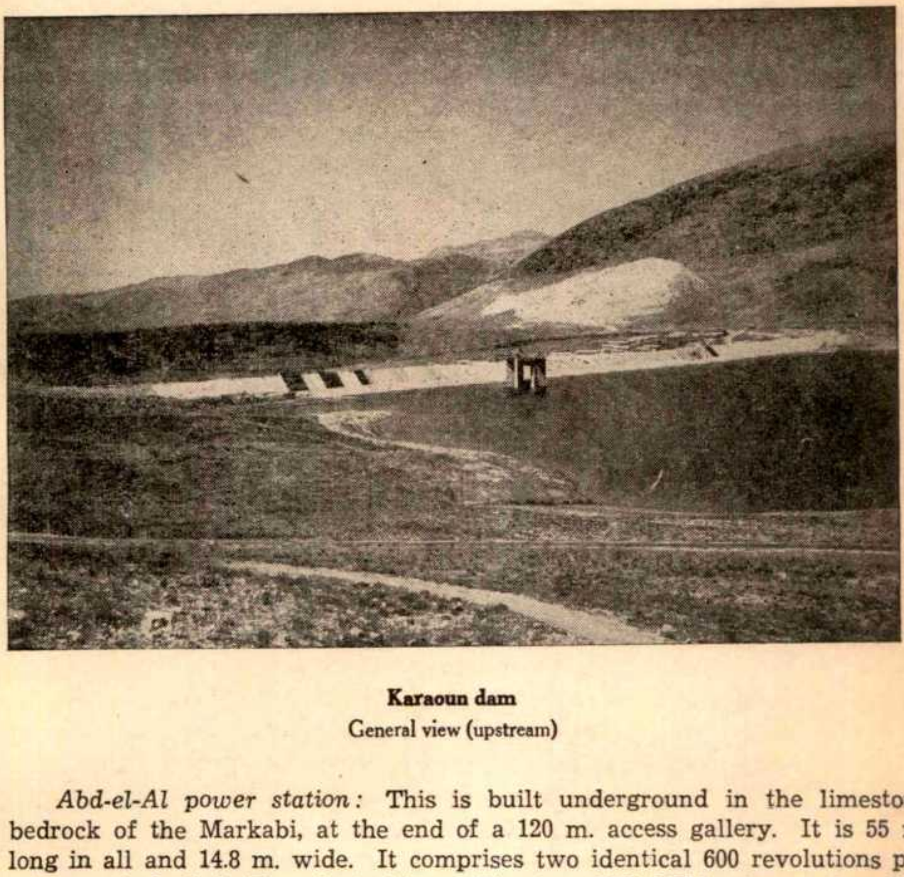
The salient details of this scheme are given below:

Water intake: Two 2.6-m. diameter butterfly gates installed in a reinforced concrete chamber beneath the rockfill.

Headrace gallery: Under pressure in the limestone deposits of the right bank of the Litani, this gallery is 6.4 km. long and 3.1 m. in diameter. It is lined with reinforced concrete. Watertightness is enhanced by cement grouting. Maximum diverted throughput is 22 m.^{3} per sec. and slope downstream 2.2%.

Balance chamber: This consists of a vertical shaft of 4.2 m. in diameter and 70 m. high which discharges at the top into an external surge chamber in reinforced concrete 22 m. in diameter. The lower chamber consists of 120 m. of horizontal gallery and 4.2 m. in diameter.

Penstock: This is a 200 m. long lined gallery comprising a 140 m. high vertical shaft. Its diameter varies from top to bottom from 3.1 to 2.55 m. The 2.6 m. diameter butterfly type head gate lies in an underground chamber. At its downstream end, the conduit divides into two branches each supplying one set.



Karaoun dam
General view (upstream)

Abd-el-Al power station: This is built underground in the limestone bedrock of the Markabi, at the end of a 120 m. access gallery. It is 55 m. long in all and 14.8 m. wide. It comprises two identical 600 revolutions per min. vertical shaft Francis turbines. The two 21.5 MVA step-up transformers lie inside the powerhouse.

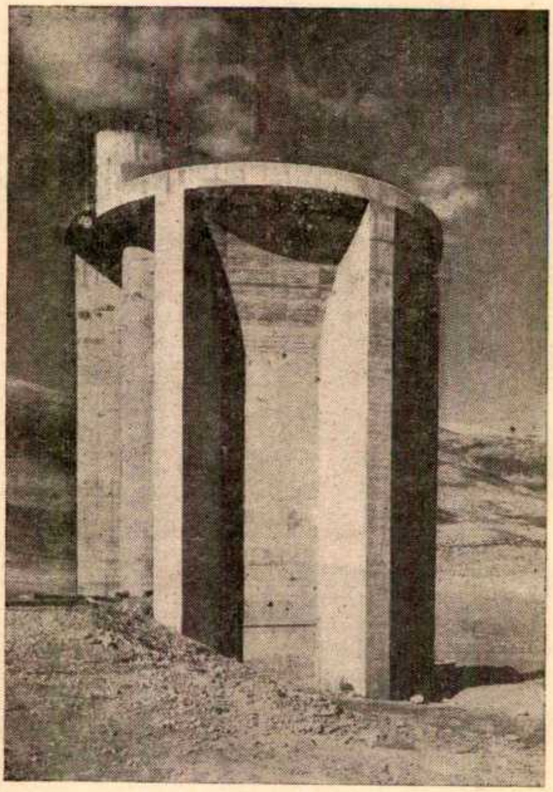
5. The Awali scheme and the Paul Arcache power station

This scheme consists of the following:

Markabi water intake: This comprises a small concrete dam on the Litani, below Markabi power station. The waters are discharged into an underground flushing gate before mixing into those of the Awali tailrace and being sent into the Awali tunnel.

Awali tunnel: This is a gallery which flows freely downstream and under pressure upstream, as it had to rise from the upstream end. It is 16 km. long in all, 3.3 m. in diameter and of circular or horseshoe section. Maximum throughput is 25 m.^{3} per sec.

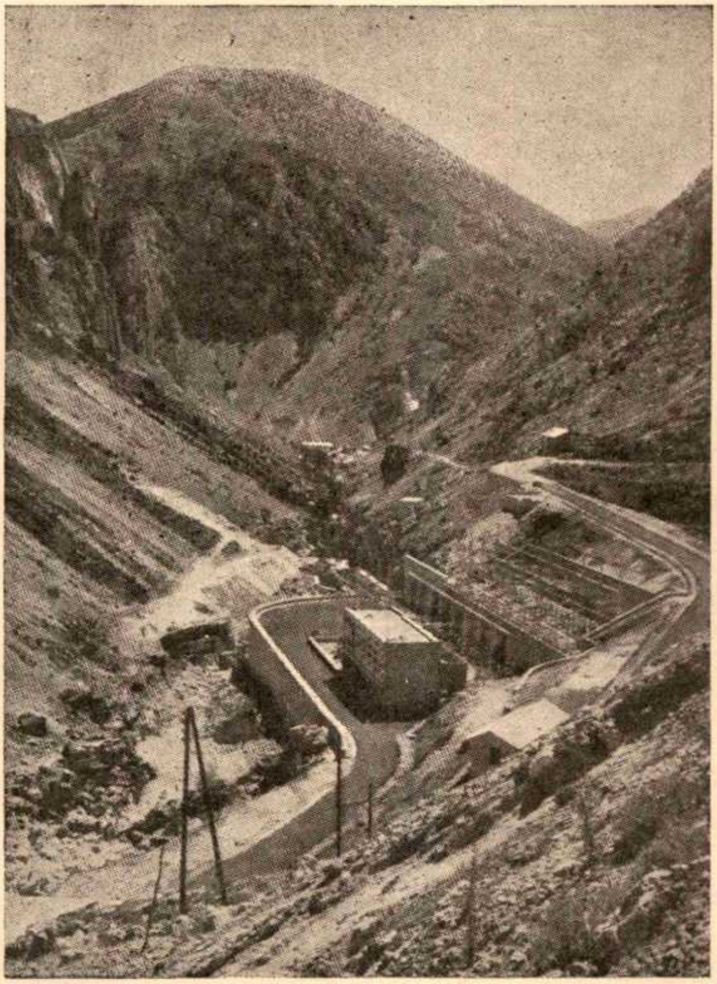
The Kanane balancing reservoir: This acts at the same time as pressure chamber for the penstock and reservoir intended to balance the difference between the inflows of the headrace tunnel and the offtakes of the Awali power station, to which those going to irrigation will also be added. Its effective storage volume is 150,000 m.^{3} It was formed by means of a dam about 18 m. high and 140 m. long. It consists of a dyke built from compacted small rockfill made watertight upstream by concrete slabs forming part of the general watertight facing, of the same type as for the storage volume as a whole. A water intake equipped with a fixed roller gate supplies a short tunnel *via* which the water is fed to the penstock.



Karaoun dam
Flood discharge system

Penstock: Total length is 800 m. and diameter varies from 3.2 to 2.6 m. from top to bottom. From the head gate chamber, equipped with a 3.2 m. diameter butterfly gate, the penstock lies first above the ground for about 350 m. and then in an inclined gallery for 450 m. as far as the collector of the power station.

Paul Arcache power station : This is a conventional external power station built on the alluvial deposits on the banks of the Bizri. Certain difficulties meant that cast piles had to be driven in. The power station is equipped with two vertical shaft sets each consisting of a 5-jet Pelton turbine supplied by S.F.A.C. and Neyrpic, rotating at 428 revolutions per min. 46 MVA step-up transformers are installed outside, like the two 71/71 kV auto-transformers equipping the substation. The power station was commissioned in May 1965, although the headrace tunnel was not yet complete. The seepage were discharged from the gallery, added to the flows of two intermediate water intakes, those of the Jezzine and Aazour streams, could be allowed to accumulate in the Kanane reservoir. In this way, it was possible to solve the teething problems and make all adjustments before final commissioning in August 1965 when the headrace tunnel works were completed.



Markabi power station

6. The Joun scheme

Work was started at the end of summer 1965 and commissioning is planned for 1968. The Joun falls, which are the farthest downstream of the scheme as a whole, will be the most affected one in the future by offtakes for irrigation. Hence the idea of keeping in hand the possibility of subsequent conversion into a pumping station in which all or part of the turbine flow could be recycled from a downstream to an upstream pool. The usefulness of the upstream pool was moreover justified for compensating the differences in operating conditions between the short-storage volumes of Awali and the operation of Joun.

The following are the details of the scheme:

The Kanane water intake and pool: The intake consists of a small dam on the Bizri at the Abed-el-Al power station. The water, combined with that from the Awali tailrace, is fed into an artificial storage volume of 300,000 m.^{3} formed from a peripheral rockfill dyke built on the material thrown up by the river. The pool is made watertight by a layer of bituminous concrete.

Headrace gallery: This is subjected to a slight pressure and has a lined horseshoe section. It lies completely on the right bank of the Bizri in calcareous or marly-calcareous terrain of acceptable quality. Construction was entrusted to a Lebanese concern who obtained the collaboration of French specialists. It is 6.6 km. long and 3.4 m. in diameter and its equipped throughput is 30 m.^{3} per sec. An intermediate access opening enables the length of the sections to be drilled to be limited.

Penstock: This lies above ground. It is about 300 m. long and diameter varies from 3.1 to 2.8 m. It has a butterfly type gate at its head at the downstream end of the gallery.

Power station: There was some hesitation between choosing pump/turbine sets or sets with the pump and turbine separated. In the end, the latter solution was adopted, one of the reasons governing this choice being that it enables the pumps which will only become necessary in a fairly distant future, to be installed later. In the initial stage, therefore, the power station will consist of two 25 MVA horizontal shaft sets equipped with a Francis turbine. Space for the pumps will be set aside at the opposite end of the alternator shaft. The power station will be of the above-the-ground type, set slightly into the limestone rock of the right bank of the Bizri.

Downstream pool: In its final stage, this will have a storage volume of about 250,000 m.^{3} and will be built in the bed of the Bizri. The existence of a pronounced bend in the river at this spot will enable the Bizri to be diverted at a little cost during flood periods.

7. Observations and conclusions

The project described here represents a considerable effort for a country of the size of the Lebanon. On the electrical side, they enable more energy than was consumed in 1963 to be generated. Capital expended in recent years represents a considerable percentage of the country's budget.

In carrying out the work, the National Office for the Litani River had to face considerable difficulties and the two fundamental assumptions, namely, the watertightness of the storage volume and the possibility of bringing the water to the Mediterranean side of the watershed after crossing the Lebanon mountain chain, were confirmed during 1964. Until then, it was difficult to press forward towards an irrigation programme and this is the principal reason for the delays in carrying any such work into effect, and it is now hoped that this lag will be eliminated soon.

Summaries of Papers Published in the Journal, vol. 47, no. 3 pt. MM 1 November 1966

MINING AND METALLURGY DIVISION

621.791.3

1. Bimetallic Welding. Dr. Bhanu Prakash, *Non-member*

The paper surveys the common methods of soldering and brazing of dissimilar metals for appraising the modern concept of bimetallic welding. In general the factors involved in such welding are: (i) Welding temperature of individual metals and their plastic range, (ii) Various thermal and electrical properties, (iii) Relative size effect, (iv) Control of atmosphere, and (v) Choice of filler rod or electrode material. These factors have been briefly discussed and explained with the help of suitable examples. The requirements of modern welding apparatus for this new technology have been critically reviewed. The scope of modern welding apparatus for this new branch of welding technology has been critically analyzed.

622.28

2. Some Problems Relating to Ground Stresses. R. S. Mishra, *Associate Member*

Pressure manifests itself in the working places as well as in the mine as a whole. The control of immediate roof is known as 'roof control' and on the larger scale as 'strata control'. To have effective strata control, it is necessary to know the stress concentration and distribution in the rock before mining and during mining. Good roof control can be achieved by suitably planning the mine keeping in view the physical and geological properties of the rock and coal seam. This paper emphasizes that suitable timbering rules should be framed for the mine and support should be given accordingly.

669.18

3. Logistics in Steelmaking. F. W. Rys, *Non-member,* **R. Easton,** *Non-member,* **and R. E. Powers,** *Non-member*

The basic oxygen process sets a fast steelmaking schedule. Continuous casting of billets and blooms present it own requirements for scheduling. Certain features including time cycles of these two modern processes are discussed. Then the manner in which they are coordinated in a common operation is reviewed, showing the design parameters for the facilities provided and the expected cycles on which they will function. The principles are illustrated by the design of a large new B.O.F.—continuous casting plant which Koppers is building.

669.162.2 : 669.4 : 669.5.004 86

4. Recovery of Lead and Zinc from Blast Furnace Slag. Prof. S. Sarkar, *Associate Member*

The paper deals with all aspects of the process for the recovery of valuable materials, *i.e.*, lead and zinc from blast furnace slag. The fundamental principles involved have been discussed. Operating details of the processes adopted in different lead smelters of the world has also been incorporated. The adoption of such recovery processes from indigenous resources at this time of acute shortage of non-ferrous metals and foreign exchange difficulty has been recommended.

531.43.001

5. Metal Transfer and Wear due to Friction. Prof. R. D. Singh, *Associate Member,* **and A. K. Jha,** *Non-member*

Friction and wear are two interrelated phenomena in nature. Whenever there is friction wear is bound to follow but the amount may not be always perceptible. The removal of the material may be either in lumps or in layers and accordingly we have different relationships between normal load and the rate of wear. But these relationships are largely influenced by the nature of deformation of the surface asperities under load, *i.e.*, whether the deformation is elastic or plastic. The rate of wear has been observed to be influenced by the variables like physical and mechanical properties of the materials and their metallurgical composition, surface area of contact, applied load, surface roughness, velocity of sliding, distance of travel and surface oxidation and lubrication, etc.

Summaries of Papers Published in the Journal, vol. 47, no. 5, pts. CI 3, ME 3, and ET 2, January 1967

CIVIL ENGINEERING DIVISION

624.04 : 517.9

1. A Modified Finite Difference Method. Dr. Prakash Desayi, *Associate Member*

The useful finite difference method using the central differences is known to give satisfactory results in many problems of engineering and applied physics. However, there are certain cases in which this finite difference technique has not been found to give good results even when the size of the mesh is reduced; further a gradual increase in the number of sections within a given interval does not indicate a gradual approach towards the correct solution which is against the normally accepted and expected behaviour of the technique. This behaviour has been observed, so far, in those problems, the governing differential equations of which contain odd-order derivative terms and/or are with variable coefficients. For such problems a 'modified-finite difference equation' may be written in place of the usual one when the accuracy of the technique greatly improves and the above mentioned defects disappear. It is seen that in many cases the 'modified-finite difference equation' reduces to the usual equation on the introduction of some approximations. In this paper the procedure of writing down the modified equation is illustrated with respect to four examples. Solutions according to the 'modified' as well as the usual finite difference equations are compared with the exact ones to indicate the order of accuracy.

627.84/.88

2. **Design of Plate Steel Penstocks for Dams. N. K. Gupta,** *Non-member*

Penstocks form an important feature of hydroelectric installations. There is, however, no standard reference on the subject. For the design of Rihand Dam penstocks, a detailed study of the subject was carried out by the author. The design features of welded plate steel penstocks are discussed in this paper. Fabrication and erection of penstocks have been briefly dealt with to illustrate the practical problems to be considered in design. A simple but practical method to specify the closure time for turbine gates has also been suggested.

725.4(540)

3. **India and Industrialized Building. Lt.-Col. A. S. Johur,** *Associate Member*

Unconventional building methods were introduced in the western countries to cope with the shortage of labour, cost of transportation and material, to speed up building construction and to permit better organization of building processes by use of standardized components based on dimensional coordination and on a closer integration between design, finance, manufacture and erection. These reasons are valid and the countries of Europe have since 1948 established various industrialised building systems in the building industry. The possibility of the introduction of industrialized building method in India has been studied in the paper. It is concluded that industrialized building methods should be introduced in the urban areas after the problems of our existing industry have been resolved.

624.072.2 : 624.012.45 : 624.043

4. **Ultimate Load Design of Reinforced Concrete Beams in accordance with the I.S. Code 456-1964. S. K. Mallick,** *Non-member,* **and R. K. Narasimhan,** *Associate Member*

The ultimate load method has lately been incorporated in the Codes of several countries for the design of members in flexure and under axial or eccentric thrust. In this paper, a comparison of the recommendations of I.S.: 456-1964 with corresponding provisions of the British Standard and the American Concrete Institute is presented.

626.234

5. **Form Resistance in Alluvial Channels. K. G. Ranga Raju,** *Non-member.* **and R. J. Garde,** *Non-member.*

A few empirical methods of separating the total resistance in an alluvial channel into grain resistance and form resistance are available. This paper presents the results of some attempts made at finding the form resistance of bed undulations by actual pressure measurements. The form resistance so obtained has been compared with the values predicted by the usual methods of separation of the total resistance.

627.235 : 627.22

6. Recent changes of Visakhapatnam Beach. R. Ramanadham, *Non-member* **and R. Varadarajulu,** *Non-member*

This paper presents the study of the nature of the ocean waves approaching the Visakhapatnam coast in different seasons and their effect on circulation within the breaker-zone and of sediment transportation along the beach. The beach to the north of harbour channel is found to be rapidly changing due to the erosion by the wave action influenced by the bottom topography and the coastal structures. The storm waves during the south-west monsoon season increase the erosion, whereas the storm waves in the north-east monsoon season erode the dunes and redistribute the sediment for building up of the beach. Increased dumping of the dredged sediment on the fore-shore to the north of the harbour entrance channel and construction of suitable dykes and groynes at short distances may improve the conditions to build up the beach at present under construction.

624.131.001

7. Scour Function. Prof. N. S. Govinda Rao, *Member,* **and K. V. N. Sarma,** *Non-member*

Scour depth is known to be a function primarily of time, characteristic velocity of flow, grain size of the sediment and depth of flow. The existence of a limit for scour depth and the effect of grain size of the sediment on it are issues yet to be finally settled. In this paper scour caused by submerged two-dimensional vertical and horizontal jets is treated. The existence of limit to the scour depth for given boundary geometry and flow characteristics has been established as suggested by E. M. Laursen. The function of scour depth in terms of the various variables has been arrived at logically and tested statistically, the constants being determined experimentally. The data used is that collected by the second author and presented in his doctoral thesis and that of Laursen.

624.012.45 : 536.5.001

8. Theoretical Concepts of Pore Pressure in Soils. Dr. N. V. R. L. N. Rao, *Non-member*

This paper presents a review of the various theoretical concepts in respect of the pore pressure in soil. The role of pore pressure estimation for engineering purposes and its validity is also discussed.

624.012.45 : 536.001

9. Temperature Effects in R. C. Frames. Y. L. Sadana, *Associate Member,* **and K. C. Verma,** *Associate Member*

This paper presents a method for the analysis of R.C.C. frames considering uniform temperature change in the beams comprising a frame. The temperature effect on columns, being negligibly small, is not considered. The other possible states of temperature affecting the frames have been discussed. The theoretical aspect of evaluation of initial end-moments in case of steady state temperature of a beam or beams of the frame, which is sometimes likely to occur, has been indicated. The solved example also shows the method of finding out stiffness factors, carryover factors and initial end-moments for members with two unequal sections. The method indicated is equally applicable for any other loading on the frame.

632.53.001

10. Studies on the Effect of Retrogression in the Tail Water Supply Stilling Basin Dr. H. L. Uppal, *Member.* **T. D. Gulati,** *Non-member.* **and B. D. Sharma,** *Non-member*

The design of the Bhakra dam spillway stilling basin was finalized for a maximum outflow of 290,000 cusec, with the corresponding tail water level of EL 1206. This provided a maximum depth of 111 ft. in the stilling basin for the hydraulic jump to form. Studies carried on a number of models in the Land Reclamation, Irrigation and Power Research Institute, Amritsar, and at the Hydraulic Research Station, Malakpur, to verify this phenomenon and devise suitable measures to prevent the sweep out of the hydraulic jump are given in the paper.

SHELL STRUCTURES GROUP

624.024

11. Analysis of Thin Elastic Cylindrical Shells by Finite Element Method. S. Chakrabarti, *Non-member.*

This paper presents the analysis of thin elastic cylindrical shells, simply supported at end, subjected to any loading and for any arbitrary shape of the directrix and, any variation of thickness along the cross-section. A large number of examples worked out on IBM 1620 computer using this method have been presented in the paper to underline the inherent power and versatility of the technique. The version of the finite element developed here is somewhat different from that analyzed by previous investigators. The advantages claimed are that it reduces the size of the element stiffness matrix while ensuring perfect continuity between forces and deformations between individual elements.

MECHANICAL ENGINEERING DIVISION

620.178.3

1. A Modified Method of Accelerated Fatigue Testing. P. K. Das, *Associate Member,* **and W. C. Young,** *Non-member*

In this paper the authors present a report of the investigation carried out on the modifications suggested by the co-author Das on the Prot method of accelerated fatigue testing. In the experimental investigation S.A.C. 1020 steel was used. The fatigue tests were conducted by the stepwise stress increase method to determine the failure stress in progressive fatigue testing. From the experimental results the authors have come to the conclusion that a reasonably accurate value of fatigue limit, S_w may be determined. The Das equation from the relationship of the failure stress S_R, and the corresponding number of cycles to failure (N_R) in the progressive fatigue testing is given by $\frac{S_R}{S_e} = \frac{(N_e)}{N_R} m'$, where m', the material constant, has been determined to be 0.145 for starting stress as zero. The authors have found that the value of m' for many other metals for starting stress as zero is approximately equal to 0.145. An approximate fatigue limit, S_e, may, therefore, be determined from the equation by carrying out only one test for zero starting stress. The recommendations suggested by the authors will be a good guide for the quick determination of the fatigue limit.

621.436 : 621.438

2. The Diesel Engine in Association with the Gas Turbine. A. S. Lolwal, *Non-member*, D. M. Dhingra, *Non-member*, and R. C. Patel, *Associate Member*

On the basis that the future development of the Diesel engine is inevitably dependent upon its association with a gas turbine, this paper explores three known methods by which the association between the engine and the gas turbine may be achieved, *viz.*, turbocharging, compounding and gasifier. Potential performance attainable from these three arrangements for both 2-stroke and 4-stroke cycle engines with and without charge cooler considering various compression ratios, adiabatic efficiencies and trapped air/fuel ratios are derived by methods which are explained. It is shown that high specific outputs become possible at high manifold pressures without exceeding the established limitations for maximum cylinder pressure, maximum piston temperature and turbine inlet temperature. The characteristics in the possible ranges are compared and the conclusion is drawn that a highly supercharged 2-cycle engine used as a gas generator feeding a power turbine would provide an efficient and versatile power unit.

539.38 : 624.043 : 620.175

3. Stress Concentration Factors for Rectangular Keyways in Shafts under Pure Torsion. A. K. Paul, *Non-member*

This paper suggests the design expressions for stress concentration factors involving breadth, depth and fillet radius of the keyways on the basis of the statistical method. From the shear stress distribution diagrams around the keyways, it is revealed that the distribution of stress along the fillet curve is non-uniform and the peak stress occurs at an angular distance of 12° to 15° from the vertical line passing through the terminal of the straight bottom edge of the keyway and the centre of the circular fillet arc.

621.835.2.001

4. Graphical Construction to Determine the Angular Acceleration of a Rocker for a Tangent Cam. Prof. A. P. Jog, *Associate Member*

Generally, it is difficult to derive an analytical expression for the angular acceleration of the rocker in this particular type of cam mechanism. Graphical methods, though simple, takes a lot of time. This paper suggests a graphical construction to determine the velocity and acceleration of the rocker.

621.882.2

5. Pre-Loading of Bolts. G. V. Ramanaiah, *Non-member*

Bolt tightening is an everyday experience or observation to almost all engineers. Yet, much is not known about the necessity, extent, design criteria and measuring techniques of this apparently simple practice. This paper aims at giving the basic principles in a simple and illustrative manner for proper understanding of bolt pre-loading.

621.784

6. Film Cooling Employing Angular Injection. G. Rama Subba Reddy, *Non-member*

This paper presents a relationship between the effectiveness of film cooling, the free stream Reynolds number with the distance down-stream along the axial direction measured from the centre of the slot opening as the characteristic dimension for length, the slot Reynolds number with the slot width at duct entry as the characteristic dimension for length, and the angle of injection.

629.118 : 620.199

7. Laboratory Technique of Acceleration Test and Evaluation of Power Plant Characteristics of a Two-Wheeled Vehicle. I. N. Singh, *Non-member*

Acceleration tests are customarily conducted on roads, but the result of such tests are conflicting due to variations in testing conditions. In the present work, the road conditions are simulated in motor scooter chassis dynamometer in the laboratory. The acceleration tests of a two-wheeled vehicle are carried out on level road and different up-grades for one-rider and two-rider cases. The results of these tests along with the resistive force-vehicle velocity measurement are used for evaluating power plant characteristics. It is found that these characteristics approach the practical power plant requirements. In spite of the discrepancies and errors, this test procedure has established a laboratory technique for accelaration performances tests and a way of evaluating the power plant characteristics of a vehicle.

531.43.001

8. Mechanism of Friction. Prof. R. D. Singh, *Associate Member,* **and A. K. Jha,** *Non-member*

The force of friction is a function of the true area of contact of the mating surfaces, the normal load, and the shear strength of the materials at junctions. The value of the coefficient of friction depends upon a number of variables like area of contact, normal load, the surface roughness, velocity of sliding and the atmospheric oxidation and lubrication and it is known to change with the rise of temperature, mainly due to friction. When two surfaces, however, smooth and polished, come in contact, they touch each other only at the tips of the asperities or very minute projections projecting from the surfaces, and consequently the true area of contact is much less than the apparent or nominal area of contact. Further, the value of this true area of contact changes with load due to the elastic and plastic deformations of these surface asperities and hence the value of frictional force also changes.

621.436.001

9. Low Pressure Turbocharging of a Four-Stroke Diesel Engine and Its Performance Prediction. Dr. J. P. Srivastava, *Associate Member,* **and S. B. Srivastava,** *Non-member*

In this paper a simple method has been developed for selecting a suitable turbo-charger for a naturally aspirated Diesel engine, and for predicting the performance of the supercharged engine. The predicted performance of the supercharged engine has been compared with the experimental performance and the causes of the discrepancies are discussed.

621.436 : 621.89

10. Studies on the Break Down of Film Lubrication between the Piston Rings and the Cylinder Liner of a High Speed Diesel Engine. S. Venkatesh, *Non-member,* **and V. Parameswaran,** *Non-member*

This paper describes a simple experimental test set-up for conducting experiments to investigate the quality of lubrication between the piston rings and the cylinder liner of a high speed Diesel engine and discusses the results. It is found that as the load on the engine increases, the oil film between the cylinder liner and the piston rings breaks down much before the top dead centre position in the piston stroke.

ELECTRONICS AND TELECOMMUNICATION ENGINEERING DIVISION

535.1 : 621.371.001.8

1. Infra Red Radiation and Its Applications. S. K. Chatterjee, *Non-member*

This paper discusses the fundamental principles of infra red radiation and detection. The transmission properties of infra red radiation through the atmosphere are briefly reviewed. The sensitivity of an infra red system and the maximum range that can be attained are also discussed on the basis of the existing theories.

627.5 : 530.17

2. A Direct Discrete Analogue for Flood Routing. K. V. Ramana Murthy, *Non-member*

A direct discrete analogue based on Muskingum storage equation, for flood routing, was developed by the U.S. Weather Bureau in the year 1948. In this equation no consideration has been made for the source resistance. This paper gives the results of the investigation into the effect of the source resistance and describes a method to evaluate the correct value. The development of a practical circuit, utilizing the correct value of the source resistance and the procedure for routing the outflow discharge hydrograph are given. It also gives the development of a discharge-stage converter, to obtain the results directly in terms of stages, for facilitating purposes like flood forecasting. The outflow in terms of stage is displayed on a digital V.T.V.M., which gives directly in numbers either in ft. or in m. The applicability of the analogue is tested, for the reach of about 97 km. in length, between Baramul and Kaimundi on the River Mahanadi, by feeding to the analogue(the discharge hydrographs at Baramul and obtaining the discharge, as well as stage hydrographs at Kaimundi. For accurate results, a continuously recorded inflow discharge hydrograph has to be fed to the analogue. The analogue offers a quick and accurate method for routing flood waves for all those reaches for which Muskingum storage equation holds good.

AUTOMATIC CONTROL GROUP

621.52

3. A Temperature Regulator for Low Capacity Baths. J. S. Gupta, *Associate Member*

The problem of temperature regulation varies very widely. The actual design of the regulator depends on the system whose temperature is to be regulated as well as the accuracy desired. In this paper, a general development of the temperature regulators has been reviewed and a design procedure regulator for low capacity bath has been illustrated by an example.

517.94

4. Description that Determine the Transient Performance of Linear and Nonlinear Systems. T. R. Natesan, *Non-member*

This paper deals with the effect of transient descriptors such as rise time, peak time, settling time, etc., on the performance of a closed loop linear and non-linear second order systems having a synchro as error detector. These descriptors mainly depend on the figures of merit, *viz.*, the damping ratio and the natural frequency of oscillation of the system. The non-linearity of the synchro is taken into account and a comparison is made between the linear and non-linear transient descriptors. It is reasonable and justified when non-linearity of synchro is ignored under steady state operation. But since the error is large during transient behaviour, it is necessary to consider non-linearity. The problem is analyzed for step and ramp input and the deviation of the results from being concurrent, is discussed. The graphs presented in the paper give these values quickly for linear and non-linear systems without compensation.

INSTITUTION NOTICES

Application forms for Sections A and B of the Associate Membership Examination to be held in May 1967

Application forms for Sections A and B of the Associate Membership Examination to be held in May 1967, are attached to this issue of the *Bulletin*. Detailed instructions along with programme are attached with the application forms and they may be detached for reference, if so desired. Students are notified that no further application forms will be distributed to them.

Applications complete in all respects and accompanied by the examination fee for admission to the May 1967 examinations and two copies of passport size photographs pasted in the spaces provided on the application form should reach the Head Office **before 4.00 p.m. on Wednesday, March 15, 1967.**

Rechecking and retotalling of marks

Candidates wishing to have their answer-books rechecked and retotalled must apply to the Controller of Examinations by name, enclosing a postal order for the fee to be paid for this purpose along with the application. This will facilitate rechecking of answer-books. Remittance of money in any other form or without enclosing the postal order with the application, or applications to the Controller of Examinations not addressed by name, may result in unnecessary delay.

Transferring of exemptions obtained in the old scheme of examination (since discontinued) to the existing scheme of examinations

Candidates who have secured exemptions in subjects of the Old Scheme of examination held upto and including the November 1965 examinations, and desire to appear in the May 1967 examinations may fill in the appropriate name of the subject (s) in the exemption column after consulting the list published in the December 1965 issue of the *Bulletin*.

ADDENDUM

TO VOL. 16, NO. 4, DECEMBER 1966

Please add the following in the 'Names of Successful Candidates in the Studentship and Associate Membership Examination held in May 1966' published in the *Bulletin* for December 1966, pages 50-59.

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B

Civil Engineering

Roll No.	Name of candidate
178	B Hasso Nichani

INSTITUTION NEWS

Mysore Engineers Association Centenary Lecture

The Third Mysore Engineers Association Centenary Lecture was delivered by Shri M. Hayath *(M.)*, Power and Industry Development Adviser, ECAFE, on the subject 'Regional Power Development'. The Lecture was organized concurrently with the 32nd Annual General Meeting of the Mysore Centre on December 17, 1966.

Award of the Mysore Engineers Association Centenary Scholarships

In accordance with the terms of amalgamation of the Mysore Engineers Association with the Institution of Engineers (India), three scholarships, named 'Mysore Engineers Association Centenary Scholarships', were established at the Mysore Centre of the Institution. The scholarships for the current year have been awarded to (i) U. Damodara Kiri, B.M.S. College of Engineering, in Civil Engineering; (ii) H. Laksmikantha, University College of Engineering, in Mechanical Engineering; and (iii) B. K. Bhagwan, University College of Engineering, in Electrical Engineering.

LOCAL CENTRE ACTIVITIES

MYSORE CENTRE

With a view to finding out ways and means for achieving economy in the use of steel, the Mysore Centre had organized a Seminar on 'Economy of Steel' at Bangalore on September 6, 1966. Several experts intimately connected with the subject took part in the Seminar and presented papers on specific aspects of the subject. Dr. K. T. Sundararaja Iyengar (*A.M.*), Professor, Indian Institute of Science, Bangalore, led the discussions. Four papers entitled (i) 'Saving of Steel in the Constructional Activities' by Dr. Nagaraja Rao; (ii) 'Economy of Steel' by K. A. Nanjappa; (iii) 'Economy in Steel in R.C. Structures Due to Redistribution of Internal Forces' by R. Nagaraja; and (iv) 'Brick Shear Walls Bound with Structural Steel' by Dr. C. K. Murthy were read and discussed.

The Engineering Research, Development and Consultancy Centre of the Institution took active part in arranging the Seminar.

A Seminar on 'City Architecture' was organized by the Mysore Centre of the Institution at Bangalore from December 10-11, 1966. His Excellency Shri V. V. Giri, Governor of Mysore, and Honorary Member of the Institution of Engineers (India) inaugurated the Seminar which was presided over by Honourable Shri R. M. Patil, Minister for Municipal Administration, Development and Panchayat Raj, Government of Mysore. The main object of the Seminar was to make a close study of the problems for organized and regulated urban growth. An exhibition highlighting the possibilities of planned city growth was also organized.

Inaugurating the Seminar, the Governor said that the rapid growth of the city since the last 20 years and the population growth from 4.7 lakhs in 1941 to 13 lakhs in 1961 had created many complex, social and economic problems. The number of slums in the City was now 130 and 80% of the population lived in slums. His City Cleaning Campaign and the Central Committee representing various voluntary service organizations set up by him had made the people civic-conscious. If this campaign was 'persistently and consistently' followed, Bangalore would soon be worthy of emulation by other cities.

The Governor called upon the Bangalore beautification planners to set up a special committee for follow-up action on the recommendations made by experts to restore the reputation of the city.

Shri R. M. Patil in his speech praised the Governor for his interest in beautifying the city and keeping it clean. He said there was a great need for a comprehensive plan to meet the needs of the people 50 years hence. Town planning had now been activised with the assistance of the Central Government. Surveys were being held in various towns and industrial centres.

The Seminar was held in four groups, *viz.*, (i) Problems of the city and the need for good architecture; (ii) Zoning of the city for controlled growth-floor space index and planning concepts; (iii) City architecture—Associate problems, public health, electricity, telephone and traffic control; and (iv)

Suggested control measures—Licensing of architects and surveyors, bye-laws revisions, forward planning, organized development, and problems of coordination. The final recommendations of the Seminar were presented at the concluding session.

FORTHCOMING EVENTS

First All-India Machine Tool Design and Research Conference, Calcutta, January 20-24, 1967

The Jadavpur University, Calcutta, in collaboration with the Heavy Engineering Corporation Ltd., Ranchi, the Indian Institute of Technology, Bombay, the Indian Institute of Technology, Kharagpur, Central Machine Tool Institute, Bangalore, Indian Machine Tool Manufacturers Association, Bombay, is holding the First All-India Machine Tool Design and Research Conference in Calcutta from January 20-24, 1967. The objects of the Conference are: (i) To provide orientation programmes describing the present state of knowledge in the various fields of machine tool design and research; (ii) To organize a seminar where original research papers and new design ideas would be presented and discussed; and (iii) To publish proceedings of the Conference.

The Conference will begin with orientation sessions on (i) Theory of Metal Cutting, (ii) Basic Principles of Machine Tool Design, (iii) Cutter and Tool Design—Basic Principles and Modern Advances, (iv) Basic Concept of Metal Forming, (v) Machine Tool Vibration—Basic Concept, (vi) Metal Forming Process, (vii) Machine Tool Vibrations, (viii) Numerical Control Systems—Basic Concept, and (ix) Fluid Logic Control—Basic Concept.

The programme of the technical sessions includes presentation of papers on the following topics:

(i) Basic Principles of Design and Analyses, Economics and Optimization, General Industrial Requirement.

(ii) Metal Cutting; Metal Forming; New Cutting Processes; Ultrasonic, electrospark, laser; anode cutting; etc.

(iii) Machine Tool Kinematics, design of slide ways and bearings; strength and rigidity of machine tool frames and structures; vibration of machine tools.

(iv) Automatic Control systems; Numerical control; Fluid logic systems; Application of Digital and Analogue Computers in machine tool problems.

(v) Standardization and Metrology—Metrology and instrumentation techniques including laser interferometry; Measurements of vibrations; Measurements of surface roughness; Optimization of size ranges of machine tools, etc.

(vi) Cutter and tool design; New jigs and fixtures; Design of efficient clampings devices, etc.

Further details can be obtained from Shri B. K. Mallick, Organizing Secretary, First All-India Machine Tool Design and Research Conference, c/o Department of Mechanical Engineering, Jadavpur University, Calcutta-32.

Seminar on 'Uniform Practice in Soil Classifications, Design Standards and Design of Flexible Pavements', Poona, June 1967

The Institution of Military Engineers will hold a Seminar on 'Uniform Practice in Soil Classifications, Design Standards and Design of Flexible Pavements' at the College of Military Engineering, Poona, in June 1967. The aims of the Seminar are: (i) To discuss the advantages of the various methods of soil classification with a view to select the system/systems most suitable for adoption by all authorities in the country; and (ii) To discuss methods of design of road and airfield pavements with a view to adopt a national system which is acceptable to all authorities. Contributions on these subjects, which should be submitted before January 1, 1967, are invited by the organizers.

Further details can be obtained from the Secretary, The Institution of Military Engineering, Dapodi, Poona 12.

Third International Exhibition of Industrial Electronics, Basle, November 14-18, 1967

The Third International Exhibition of Industrial Electronics will be held at the halls of the Swiss Industries Fair in Basle from November 14-18, 1967. The aims of the exhibition are (i) to take into account the rapid technological progress achieved in the industrial field, and (ii) to extend the exhibition to make room for an important new branch of industrial electronics, *viz.*, manufacturing equipment for electronic products.

Further details can be obtained from Dr. H. Hanswirth, Director of the Swiss Industries Fair, Clarastrasse 61, Basle, Switzerland.

PERSONALS

Shri S. R. Chatterjee, M. I. Prod. E. (England), M.B.I.M. (England), M.ASME., M.I.E., Works Manager, Machinery Manufacturers Corporation Ltd., and General Manager, Indian National Diesel Engine Co. Ltd., has been elected Chairman of the Calcutta Section of the Institution of Production Engineers (England) for the year 1966-67. He has also taken over as Managing Director of Jessop & Co., Calcutta. Shri Chatterjee's paper on the subject of Industrial Mangement appears elsewhere in this issue of the *Bulletin*.

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here.

Mr. W. H. C. Kelland

Mr. Walter Harold Casimir Kelland, M.I.E., O.B.E., died at Bournemouth, England, on November 21, 1966, at the age of 74. He was a Life Member of the Institution.

Born at St. Leonards in 1893, Mr. Kelland attended the Emmanuel College, Cambridge, and obtained the Mechanical Sciences Tripos in 1921, He was apprenticed at the L.S.W.R. Loco Works, Edinburgh, from 1910-12. When at Cambridge, he was commissioned in the Royal Engineers and he was in charge of Electric Lights Coy. RE(T) and was posted in Salonica, Caucasus and Constantinople during 1915-20. He came to India in 1921 and was employed as Assistant Engineer in the Bengal Nagpur Railway (B.N.R.). In 1926 he became District Engineer and in 1944 he was promoted to the post of Chief Engineer. Mr. Kelland was responsible for the construction of the Raipur-Vizianagram rail link. He returned to England in 1948 and joined No. 1 Railway (Home) Group, R.E., in Derby. He retired from service in 1961.

Mr. Kelland joined the Institution as Associate Member in 1925, and was transferred to Member in 1931.

Shri P. N. Banerjee

Shri Prabhat Nath Banerjee, B.A., M.I.E., died in Calcutta on December 16, 1966, at the age of 83.

Born at Uttarpara, West Bengal, Shri Banerjee graduated from Presidency College, and joined Trinity College, Cambridge, from where he obtained his Tripos in Mechanical Science. Returning to India, he joined Martin & Co. as Resident Engineer in 1908. He became a partner of the company in 1921. In 1927 he also became a partner of Burn & Co. He retired from the Company when it was converted into Martin Burn Ltd. in 1947. He was a member of the Advisory Board of Industries, the Board of Control of Apprentice Training, the Governing Body of Calcutta Technical School, the Bengal Engineering College and Presidency College for several years. Shri Banerjee was also Dean of the Faculty of Engineering and a Fellow of Calcutta University. He was also Chairman of the Bengal Centre of the Institution for a year. During his career, Shri Banerjee was responsible for the design and construction of several important office and residential buildings in Calcutta.

Shri Banerjee joined the Institution as Associate Member in 1921 and was transferred to Member in 1932.

Shri R. C. Bhandari

Shri Ramnath Chand Bhandari, C.E. (Hons.), A.M.I.E., died on October 23, 1966, at the age of 43.

Born at Jodhpur in 1923, Shri Bhandari took his C.E. (Hons.) degree from the Thomason College of Civil Engineering, Roorkee, in 1944 and worked in the P.W.D. for two years. In 1946, he joined the then Jodhpur State Railway as Assistant Engineer. He was promoted to the post of Divisional Engineer in the Northern Railway in 1957 and two years later he was deputed to the Ghana Railway and Harbours, Government of Ghana, and worked there for about four years. He returned to India in 1963 and after having short assignments such as Divisional Engineer, Moradabad, Civil Defence Engineer and Executive Engineer (Construction) on Singrauli-Katni and Obra-Singrauli Projects on the Northern Railway, he was posted as Deputy Director (Civil Engineering) in the Railway Board in April 1964. He was promoted as Joint

Director (Works) in the Board in May 1966, and had been working in that capacity till his death. In 1961 he undertook a study tour of railways in Italy, Switzerland, West Germany, Belgium, France and the U.K.

Shri Bhandari joined the Institution as Associate Member in 1962.

BOOK ACKNOWLEDGMENTS

1. **Analytical Applications of Ion Exchangers.** J. Inczedy (Translated by A. Pall). *Pergamon Press Ltd.,* £5-5s., 1966, 443 pages.

This book introduces the theories and analytical methods elaborated in the last ten years. To an analytical chemist, it presents the up-to-date methods applicable in the laboratories and a nearly complete summary of both inorganic and organic analytical applications of ion exchangers.

2. **Principles of Magnesium Technology.** E. F. Emley, *Pergamon Press Ltd.,* 1966, 1,013 pages.

This book is intended to relate the practice of magnesium technology to scientific principles. It illustrates the chemical background of the metal and discusses the process of extracting the metal from its ores, remelting, alloying and refining of raw magnesium, etc. It also deals with the alloy systems of practical interest, electrochemical aspects of magnesium, examples of applications of alloys, and the metallurgical background to magnesium applications in the nuclear energy industry.

3. **Atlas of the Most Important Ore Minerals Parageneses under the Microscope.** O. Oelsner (Translated by B. J. Hazzard). *Pergamon Press Ltd.,* 1966, 311 pages.

This atlas is essentilaly a pictorial record of about five hundred photographs of ore minerals as seen in reflected light. The minerals are classified according to their paragenesis and are accompanied by a tabular statement of the chemical composition, crystal system, three strongest X-ray powder reflections, relative hardness, colour, reflectivity, anistropy, and notes on the twinning and other characteristics of the individual minerals.

4. **High Resolution Nuclear Magnetic Resonance Spectroscopy—vol. 2.** J. W. Emsley, J. Freeney and L. H. Sutcliffe. *Pergamon Press Ltd.,* £5-5s., 1966, 1,206 pages.

This book is the comprehensive treatment of the theory and application of high resolution nuclear magnetic resonance in which many important recent advances are covered including methods of analyzing spectra, determination of the science of coupling constants, multi-resonance experiments, and applications to nuclei other than hydrogen.

5. **Metal Transfer and Build Up in Friction and Cutting.** V. D. Kuznetsor (Translated from the Russian). *Pergamon Press Ltd.,* £5-5s., 1966, 360 pages.

This book explains the problems of the development and properties of metal build-up in cutting, scratching and friction. A number of phenomena in cutting, scratching and sliding from the point of view of metal transfer theory have been explained.

6. **Problems in Mathematical Physics.** N. N. Lebedev, I. P. Skal'Skaya and Ya. S. Uflyand. (Translated by A. R. M. Robson). *Pergamon Press Ltd.*, 63s., 1966, 406 pages.

This book is designed to give a clear idea of the mathematical methods used in modern physics. It contains problems on different applications of methods of mathematical physics taken from various regions of mechanics, theory of heat conduction, theory of electric and magnetic phenomena, etc.

7. **Dictionary of Semiconductor Physics and Electronics.** Dr. W. Bindmann (*ed.*). *Pergamon Press Ltd.*, £8, 1965, 615 pages.

Seimconductor physics and electronics are amongst the most important and most topical fields of modern physics. This comprehensive dictionary (English to German and German to English) contains the specialized terminology.

8. **The Monte Carlo Method.** N. P. Buslenko, D. I. Golenk, Yn. A. Shreider. I. M. Subol and V. G. Sragovich (Translated by G. J. Tee). *Pergamon Press Ltd.*, 80s., 1966, 381 pages.

This book describes the properties of Monte Carlo method which consists of the simulation of random processes on digital computers. It discusses the techniques for generating and transforming random and pseudo-random numbers, methods for computing multi-dimensional integrals and the design of specialized computers for performing Monte Carlo computations.

9. **Ferromagnetic Resonance.** S. V. Vonsovskii (*ed.*) Translated by H. S. H. Massey. *Pergamon Press Ltd.*, 63s., 1966, 325 pages.

This fourth volume of international series of monographs in 'Solid State Physics' comprises a collection of papers on ferromagnetic resonance. The book is devoted to the exposition of the basic theory of the phenomenon of resonance absorption of the energy of a high-frequency electromagnetic field in ferromagnetic substances. The subject is treated both from the theoretical and the experimental point of view.

10. **Fans—vol. 1.** W. C. Osborne. *Pergamon Press Ltd.*, 40s., 1966, 224 pages.

The book embraces the simple physical principles necessary for the proper application, control and design of fans. It contains the outline designs of two types of fans and suggestions for further reading.

11. **A Laboratory Manual of Analytical Methods of Protein Chemistry—vol. 4.** P. Alexander and H. P. Lundgren (*ed.*). *Pergamon Press Ltd.*, 55s., 1966, 233 pages.

This book contains the best experimental methods for studying the chemical constitution, structures and the physical properties of proteins. It provides instructions on how to carry out the different analyses. All the contributors have described the methods they use in their own laboratories.

12. **Handbook of Vacuum Physics—vol. 2: Physical Electronics: pts. 1 and 2.** A. H. Beck (*ed.*). *Pergamon Press Ltd.*, 50s., 1966, 395 pages.

The function of this handbook is to provide the information in as up-to-date form as possible in the form of a series of volumes, each of which contains several separate contributions. This volume discusses thermionic emission and secondary electron emission.

13. **Mechanics of Liquids and Gases.** L. G. Loitsyanskii. *Pergamon Press Ltd.*, £8, 1966, 804 pages.

This sixth volume of the monographs on 'Aeronautics and Astronautics' presents the fluid mechanics from the first principles to an advanced level. The topics covered include : kinematics of a continuous medium, fundamental equations and theorems of the dynamics of an ideal liquid and gas, one-dimensional flow of an ideal gas, plane turbulence-free motion of an ideal incompressible viscous fluid, turbulent motion and dynamics of viscous gas.

14. **1965-Transactions of the Third International Vacuume Congress Stuttgard. Germany—vol. 1.** Dr. H. Adam (ed.). *Pergamon Press Ltd.*, 75s., 1966, 163 pages.

This volume contains 13 papers giving an important insight into the significance of high vacuum for our present science and technology.

15. **The Design of Prestressed Concrete.** H. J Cowan and P. R. Smith *Angus and Robertson Ltd.*, Sydney, $A.8 50, 1966, 212 pages.

This book is intended to present the subject matter on prestressed concrete for engineers and architects of undergraduate and post-graduate levels. The designs conform to the Standards Association of Australia's codes for use of prestressed concrete in structures.

16. **Physical Metallurgy—Vol. 1.** Dr. P. R. Khangaonkar. *A. V. G. Prakashan*, Poona, Rs. 9, 1966, 231 pages

This book gives a concise account of the physical metallurgy of engineering alloys.

PUBLICATIONS RECEIVED

Copies of the publication entitled 'Metal Working' 'Building and Civil Engineering', 'Stone Industry', 'Ceramics', 'Diamonds in Metal Working', and 'Non-cutting Uses of Industrial Diamonds' have been received from the Industrial Diamond Information Bureau, London. These publications explain the various uses of diamond in the engineering industry.

Copies of report no. A 2 and A 3, August 1966, have been received from the Central Mechanical Engineering Research Institute, Durgapur. These reports contain papers entitled 'Application of High Frequency Sound in Fuel Oil Burners' and 'Investigations on Helmholtz Type Pulse Combustor'.

A copy of publication entitled 'New Product Catalog, 1966' has been received from the Soiltest, Inc., Illinois. It lists more than 400 items of testing equipment for soils, concrete, bituminous products and construction materials.

A copy of a publication entitled 'Bulletin for General Information 1966-67' has been received from the Indian Institute of Technology, Kharagpur. This publication contains (i) Academic Calender for Undergraduate and post-graduate courses, (ii) Holidays and Vacations, (iii) Undergraduate programme, (iv) Post-graduate programme, (v) Short-term programme, (vi) Technical teachers' training programme, (vii) Special features, (viii) Scholarship and fellowships, (ix) Information for students, (x) Academic information, (xi) Financial information, (xii) Working of departments, library and central workshops, and (xiii) Administrative and academic set up of the I.I.T., Kharagpur.

A copy of a publication entitled 'Information Brochure for Post-graduate Courses 1966-67' has been received from the Indian Institute of Technology, Kharagpur. This publication gives an introduction to the I.I.T., Kharagpur, and details of the duration of the courses offered, mode of application, selection of students, scholarships available and similar information useful to students seeking admission in the I.I.T.

A copy of a publication entitled 'Annual Review' has been received from the Bangalore Centre of the Institution of Telecommunication Engineers.

A copy of the second special publication entitled 'Profiles in Productivity' of the Baroda Productivity Council, Baroda 5, has been received. This publication contains case histories of actual applications of productivity techniques to company problems. It also serves as an answer to criticism that productivity techniques are merely theoretical exercises.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, Industrial and other organizations employing engineers. It is hoped that employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column, a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta, except where otherwise stated.

SITUATIONS WANTED

CIVIL ENGINEER, aged 32, passed B.Sc. in 1st class, Sections A and B of A.M.I.E. (India) with good percentages, working in Railway since last 10 years, experienced in surveying, designing, estimating, billing, earthwork, construction of bridges and buildings, and varieties of works pertaining to Railway; seeks a permanent job in a private firm on a start of Rs 700.00 p.m. in the States of Maharashtra, Mysore, Andhra Pradesh, etc.; prepared to work either indoor or outdoor. (Office ref. E.S. 267).

QUALIFIED ELECTRICAL ENGINEER, B.Sc., B.Sc. (Engg.), Grad. I.E. (India), 24½ years old, good personality, energetic young man, having first class B.Sc. degree with fifth position in order of merit from Lucknow University and also first class electrical engineering degree from B.H.U., with the experience of about 2½ months in dealing with the design and purchasing of instruments for a test laboratory to be set at Kanpur and about a year's experience as an Associate Lecturer in Electrical Engineering Banaras Hindu University, is interested in seeking a job in the private industry of world repute or central Government undertaking and ready to take training in new fields. (Office ref. E.S. 269).

YOUNG ENGINEER, Grad. I.E. (India), having first class degree in Mechanical Engineering with nearly one year experience in project works, stock and storage controls, inventory controls, etc., wants a suitable change in industry; at present drawing Rs. 580.00. (Office ref. E.S. 248)

GRADUATE in science, passed Section A and part of Section B (Civil) of A.M.I.E. (India) examination, age 24 years, one year experience in indenting of scientific stores through D.G.S. & D. and India Supply Mission, London, and one year experience in quality control of civil works on a major power house project can handle independent scientific translations and correspondence in English—Italian —French—German; seeks suitable employment and part-time translation work. (Office ref. E.S. 270).

SERVING CAPTAIN in the Army, 33 years age, passed Section A of A.M.I.E. (India) will be available for employment in civil after April 1, 1967; having 11½ years experience in the Air Force as ground technician in the electrical branch; served for 3½ years as a Commissioned Officer (Gazetted Class I) and gained veluable administrative experience; present emoluments Rs. 960.00 plus free food, lodging and conveyance; salary expected around Rs. 600.00; job acceptable of Engineer/Administrative/Security Officer, preferably in a reputed firm. (Office ref. E.S. 271)

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	Text Book of Electrical Technology (M.K.S.A.)	25.00
	Also in Parts : Vol. I (A.C.) ..	12.50
	Vol. II (D.C.) .	12.50
	Advanced Problems in Electrical Engineering	12.50
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Metallurgy

Kehl	Principles of Metallographic Laboratory Practice .	15.00
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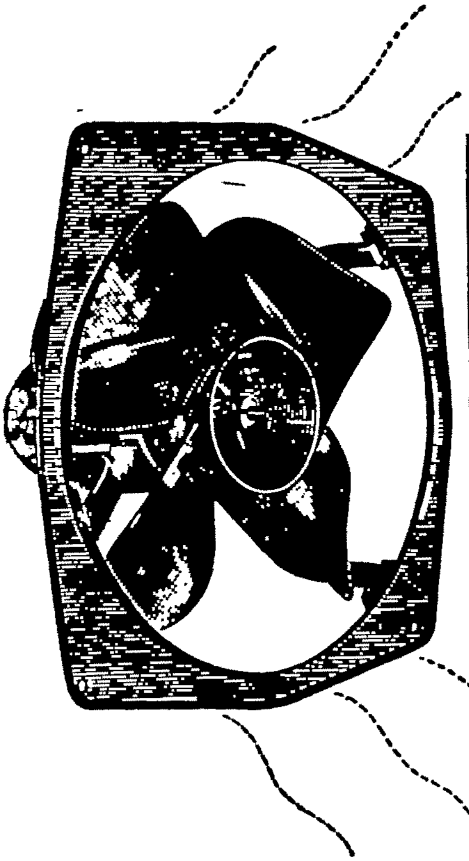

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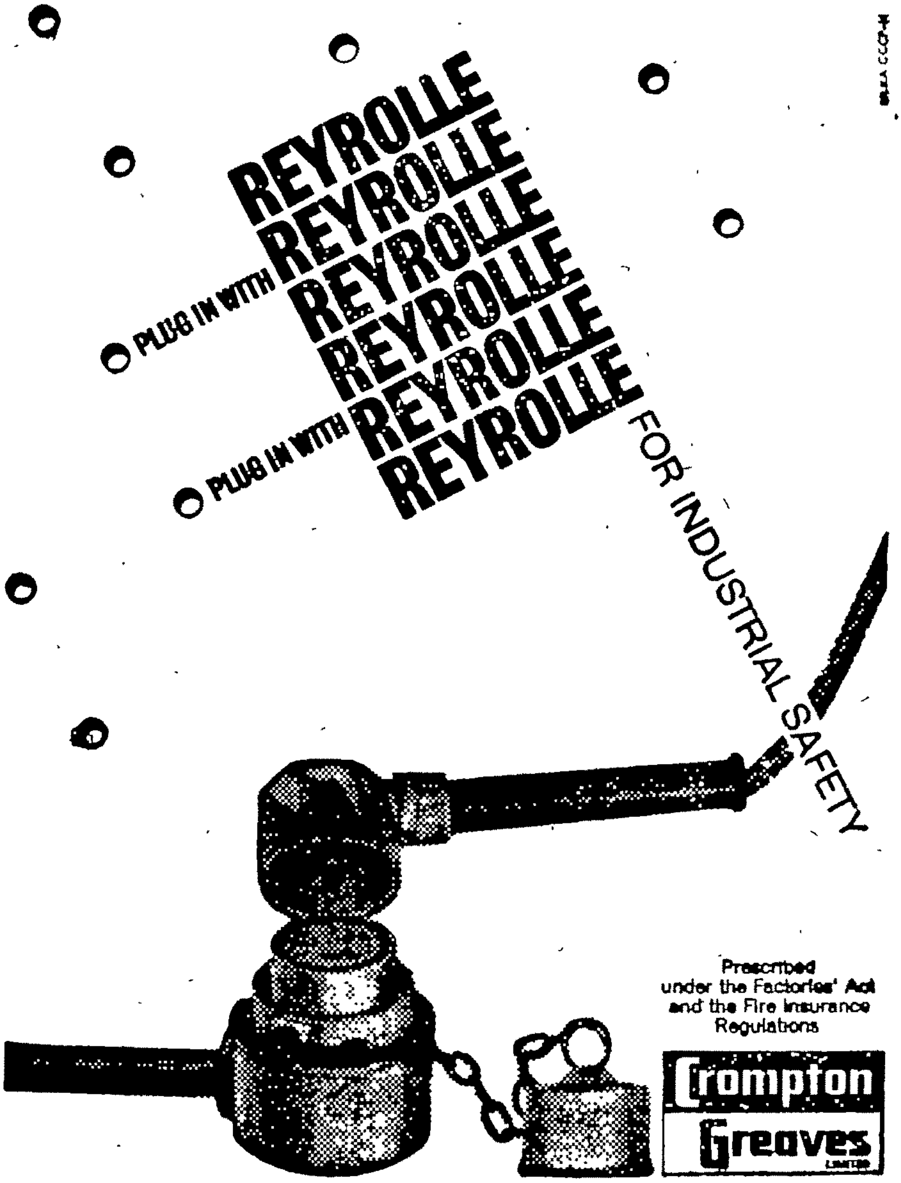
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THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

May 1967 Examinations

General information and instruction to candidates

(Approved by the Examinations Committee, 51st Meeting, Resolution 21, 30th December, 1958)

(Revised by the Examinations Committee, 57th Meeting, Resolution 19, 27th-29th June, 1961, and 58th Meeting, Resolution 10, 13th and 14th October, 1961).

(1) The next Associate Membership (Sections A and B) Examinations will be held in May 1967, the programme of which is enclosed. The application forms for the Associate Membership (Sections A and B) are also enclosed.

(2) **All applications accompanied by examination fees for admission to the May 1967 examinations should reach the Head Office before 4.00 p.m. on Wednesday, March 15, 1967.** Examination fees once paid are neither refundable nor transferable to a subsequent examination or to any other account. Receipt of examination forms will not be acknowledged by the Head Office, unless accompanied by a self-addressed post-card.

(3) **Examination fees should be preferably deposited at the State Bank of India in the candidate's locality. Attention of the candidate is specially drawn to item 3 in Form 383 and item 5 in Form 384 in this regard. The instructions for making such payment are given in Card A (attached herewith) and on its reverse. Other modes of payment may be used only if this is not possible. Payment of examination fees by cheque, postal orders or money order will not be accepted.**

Mention the code number as given in the top of the application form in the bank card.

(4) No application for a change of examination centre will be entertained after 4.00 p.m. on Wednesday, March 15, 1967.

(5) Students who are in arrears of subscription will not be admitted to the examinations.

(6) **The Institution reserves the right to reject incomplete or illegible applications without any reference to the candidate.**

(7) No Student will be permitted to appear in the Section B examination unless he has fully passed the Section A examination or secured exemption therefrom. A candidate for the Section B examination should therefore mention the year in which he passed the Section A examination.

(8) Students appearing for the Section B examination under the revised rules 17(a) to 17(i) of the rules of examinations (see Rules and Syllabuses of Studentship and Associate Membership Examinations) should clearly state in the application form the name of the Local Centre to which they are attached.

(9) A candidate who has already passed the Section A and B examinations or is exempted therefrom will be permitted to appear in any paper or papers of Section A and/or Section B on payment of an examination fee of Rs. 50.00 per paper. The details of passing the Section A and B examinations or of exemption therefrom should be clearly stated in the examination form, with the grade of membership.

A candidate may also appear in one complete branch of engineering on payment of usual examination fee of Rs. 75.00. Rules of examination for such a candidate will be identical with those applicable to regular candidates.

(10) The Design and Drawing papers are of 5½ hours duration, with a one-half hour recess between. Candidates will not, however, be permitted to leave the examination hall.

(11) Candidates are not permitted to use handbook(s) for the paper in 'Design and Drawing' of Section B. They may, however, use steel tables of the Dorman-Long type.

General information and instruction to candidates—*(contd.)*

(12) Candidates detected using unfair means in the examination hall will be expelled from the Institution and will not be re-admitted to the Institution at any future time.

(13) Candidates reappearing in subject(s) in which they have already secured exemption(s) will have their paper(s) cancelled. The previous exemption(s) will stand.

(14) It is sometimes found that candidates do not enter their Studentship Number, Roll Number, or other necessary particulars on the answer-books. Such answer-books will be rejected and no attempt will be made to locate the candidates. Candidates should therefore take particular care to write down these particulars on the answer-books correctly.

(15) The results of the May 1967 examinations will be declared before the last day of August, 1967.

(16) Candidates will be permitted to apply for the checking of their answer-books as to whether the marks allotted in the answer-books were added correctly and all the answers within the answer-books were appropriately marked, on payment of Rs. 5 as checking fees for each paper. Candidates wishing this check to be made should apply to the Controller of Examinations within 15 days of the date of posting the results by him.

(17) **The marks of each examination will be communicated to candidates along with results free of charge.**

(18) The Institution reserves the right to cancel the results of any candidate without assigning reasons in which case, the marks will not be supplied.

(19) In any future correspondence, in regard to the May 1967 examinations, candidates should always mention the Section of the Associate Membership Examination in which they appeared and their centre of examination in May 1967.

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

May 1967 Examination

Programme

	S.T. 10.00 to 1.00	S.T. 2.00 to 5.00
	Studentship Examination	
Monday, May 15, 1967	English	Mathematics I
Tuesday, May 16, 1967	Mathematics II	Physics
Wednesday, May 17, 1967	Chemistry	
	Associate Membership Examination—Section A	
Monday, May 8, 1967	Mathematics I	Mathematics II
Tuesday, May 9, 1967	Applied Mechanics	Principles and Applications of Electricity
Wednesday, May 10, 1967	Heat, Light and Sound	Engineering Drawing
Thursday, May 11, 1967	Strength of Materials	Elementary Surveying
	Associate Membership Examination—Section B	
Monday, May 15, 1967	Materials and Construction Mechanical Engineering Materials Electrical Engineering Materials Chemical Engineering Materials Principles and Practice of Coal Mining Mineral Dressing Electronics and Telecommunication Materials	Theory and Design of Structures Industrial Organization and Management Theory and Performance of Electric Machines Industrial Stoichiometry and Mechanics of Fluids Principles and Practice of Metal Mining Physical Metallurgy and Physical and Mechanical Testing of Metals
Tuesday, May 16, 1967	Structural Engineering Generation, Transmission and Distribution of Electric Power Diffusional Process, Evaporation and Distillation Mine Ventilation, Explosions, Fire and Inundation Refractories Applied Electronics and Circuits	Surveying and Geodesy Theory of Machines Electric Traction Fuels and Combustion Mine Surveying Foundry Engineering Transmission Lines and Networks
Wednesday, May 17, 1967	Hydraulics Industrial Engineering Illumination Engineering Elementary Electrical Engineering Mineral Dressing Practice Metallurgical Analysis Advanced Radio and Electronic Engineering	Highway Engineering Fuels and Refractories Radar Engineering and Microwave Techniques Workshop Technology
Thursday, May 18, 1967	Civil Engineering Design and Drawing Mechanical Engineering Design and Drawing Electrical Engineering Design and Drawing Chemical Engineering Design and Drawing Electronics and Telecommunication Design and Drawing	(From 10 a.m. to 1 p.m. and 1.30 p.m. to 4 p.m.).
	Mining Machinery Physics of Metals	Generation, Distribution and Utilization of Power in Mines Metallurgy of Less Common Metals

Programme—(*contd.*)

Friday, May 19, 1967	Geology Production Technology Non-ferrous Metallurgy	Thermodynamics and Heat Engines Size Reduction, Mixing and Separation Telegraphy and Telephony
Saturday, May 20, 1967	Railways General Mechanical Engineering	Hydraulics and Hydraulic Machinery
Monday, May 22, 1967	Irrigation Engineering Refrigeration Line Communication Gas Engineering Mining Geology Industrial Metallurgy Antenna and Wave Propagation	Harbours and Dock Drilling Engineering Television Utilization of Electric Power Principles of Heat Transmission and Furnaces
Tuesday, May 23, 1967	Metallurgy of Iron and Steel Industrial Administration	Water Power Engineering Electrical Measurements Heat Treatment of Metals and Alloys
Wednesday, May 24, 1967	Public Health Engineering Railway Locomotives and Rolling Stock General Electronics Refrigeration and Air-Conditioning Mine Economics Electrometallurgy and Hydro-metallurgy Electronic Measurements	Thermal Power Engineering Servomechanisms
Thursday, May 25, 1967	Town Planning Automobile Engineering High Frequency Currents Chemical Works Organization and Management Metallurgy and Assaying Fuels and Furnaces Industrial Electronics	General Electrical Engineering
Friday, May 26, 1967	Architecture Air-Conditioning Radio Communication Materials and Mechanical Construction of Chemical Plants Mine Design and Planning Metallurgical Thermodynamics Radio Communication Systems	Soil Mechanics and Foundation Engineering Aerodynamics Hydro Power Engineering Metallurgy Mine Organization and Management Engineering Metallurgy Audio Frequency Engineering
Saturday, May 27, 1967	Production Technology and Industrial Engineering Principles of Semi-conductors and Transistor Circuits	Agricultural Engineering Thermodynamics Carrier Current Engineering
Monday, May 29, 1967	Principles of Line and Radio Communication	

THE INSTITUTION, ITS LOCAL CENTRES AND SUB-CENTRES

Headquarters

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Local Centres

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Rajasthan	C-40 Sarojini Marg, C Scheme, Jaipur *(Telephone 73327)*
Uttar Pradesh	River Bank Colony, Lucknow *(Telephone 25322)*.

Sub-Centres

Allahabad	9 Kanpur Road, Allahabad.
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Bhilai	Works Office Building No. 3, Bhilai Steel Works, Bhilai, Madhya Pradesh.
Bhopal	112 Type III, B Sector, Piplani P.O., Bhopal, M.P *(Telephone 791 City)*.
Coimbatore	C/o Prof. G. R. Damodaran, Principal, P. S. G. College of Technology, Peelamedu, Coimbatore-4.
Dhanbad	P.O Sindri Institute, Dhanbad.
Dharwar	C/o Shri A. B. Ramanand, Superintending Engineer, I Division, P.W.D., Dharwar.
Durgapur	C/o Deputy Chief Engineer (Civil), The Durgapur Projects Ltd., P O Durgapur-2, District Burdwan, West Bengal *(Telephone DGP-24)*.
Jammu	C/o Executive Engineer, Irrigation Division, Jammu.
Jamshedpur	C/o Drawing Office (E G.), TELCO, Jamshedpur-4 *(Telephone 612/57)*.
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Neyveli	Central Technical Office, Block 1, Neyveli 1, Madras State *(Telephone 2361)*.
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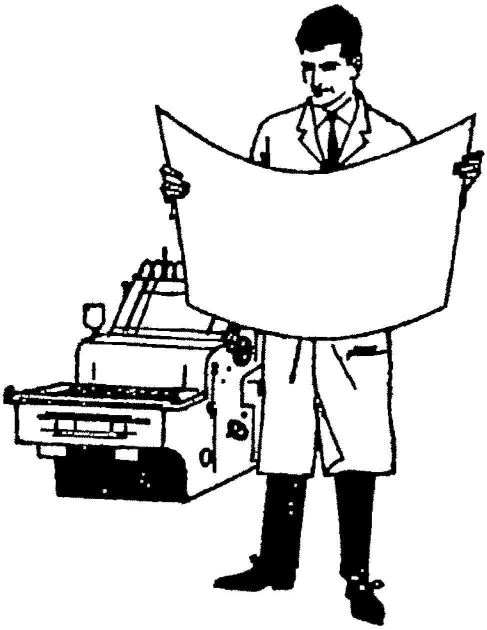

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PROCEEDINGS OF THE FORTY-SEVENTH ANNUAL GENERAL MEETING, BOMBAY, FEBRUARY 24-28, 1967

The Annual General Meeting

Business Session, Friday, February 24, 1967

The Forty-Seventh Annual General Meeting was held in the building of the Bombay Centre, Clerk Road, Mahalakshmi, Bombay, on Friday, February 24, 1967, at 3.30 p.m.

About 300 Corporate Members attended the meeting and the President, Shri B. P. Kapadia, was in the Chair.

The President made an introductory speech as follows:

'Major General Vohra, Past Presidents, Members of the Council, Corporate Members, Graduate Members, Student Members, Ladies and Gentlemen.

I thank you for attending the Annual Meeting in such large numbers. I have noticed for years that the Annual Meeting instead of being the most important one was just very formal and practically nothing of importance was spoken or discussed and that is why the attendance also was poor.

I thought this was all wrong; our Annual General Meeting should be like Private Limited Company's Annual Meeting. This should be the most important meeting where opportunity should be given to every Corporate Member to express his views or complaints if any, against the President, Members of the Council or the Staff and the general administration. All Corporate Members and others present should be given an opportunity to move any proposal or resolution, etc.

So, I have allowed 1 hour 15 minutes instead of usual ½ hour for this meeting. I, therefore, request all the Corporate Members present here to express their views, freely and frankly, regarding the administration of the Office and the management by the President and the Council. I hope this will meet with your approval.

After hearing you all, I shall give you my Farewell Address.'

1. The President then took up the minutes of the 46th Annual General Meeting held at Patna and circulated to all members of the Institution in the January-February 1966 issue of the *Bulletin* for confirmation. The President put the minutes to the house. Shri N. V. Joshi (*A.M.*) proposed that the minutes be confirmed. Shri S. Rajaraman (*M.*) seconded the proposal. It was carried unanimously.

2. The President then took up the Annual Report of the Council printed in the February 1967 issue of the *Bulletin* and circulated to Members and also the Audited Accounts for the year ending 31st August, 1966, and asked for the members' comments, if any.

(i) Many members mentioned that they had not received the audited accounts. The Secretary informed that the *Bulletin* containing the Auditors' report and the audited accounts were circulated to the members only on the 17th February, 1967, and so many members have not received it.

(ii) Shri S. Padhi (*M.*) requested the President that the Auditors' report be read. The Secretary read out the Auditors' report.

(iii) Col. Attre (*M.*) mentioned that from the audited accounts it was seen that the total receipt from the Student members by way of subscription as well as examination fees was nearly Rs. 35 lakhs. Against which the expenditure for Student Chapters and Examinations were quite low. The accounts also showed an extra expenditure over staff establishment of Rs. 1 lakh. The President replied that there were many other items of expenditure over the Student members, and it was not a simple arithmetic. The bulk of the members constitute the Students and therefore the big portion of the Head Office expenditure incurred by the Institution were spent for them. However, as a great supporter of the Students' causes the President mentioned that extension of facilities to Student members were being considered. Here, the President informed the house that a Sub-Committee had been formed to go into the method and work study of the Institution.

Lt.-Col. R. S. Attre (*M.*) requested the President to give more attention to the Student members' letters and othr matters straightaway without waiting for the Sub-Committee's Report and give better attention to their requirements. This was agreed to.

Shri N. M. Thadant (*M*) wanted that copies of *Journal* containing useful papers be supplied to the Members if and when asked for by them. It was also pointed out by the Secretary that the reprints of the important papers were supplied on demand.

Shri Thadani also mentioned that the Secretary should briefly mention in the General Body Meeting the activities that will be followed during the ensuing year, and mention may also be made about how many Members added and how many resigned during the year, also, as to the total income and expenditure and about the expenditure that it required for examination of answer papers, etc. Secretary stated that all this is shown in the report.

Lt.-Col. O. P. Bhatia(*A.M.*) stated that the Headquarters should give prompt and pointed reply to the Members' letters. He also stated that the Headquarters of the Institution should be of practical help to its Members in every possible way.

Dr. A. S. Arya (*A.M.*) mentioned about the grant to the Students' Chapter which was very meagre and which should be increased. He also mentioned that the technical activities of the various Students' Chapters should be extended. He pointed out that technical contents of the Institution's *Journal* were too meagre. He suggested that our technical *Journal* be made more useful towards the technical requirements of our country.

The Secretary addressed the Meeting and said that our membership was more than 69,000 and our receipt of letters every day was about 4,000. If one percent of it was complaints by nature, it would be a very high figure. However, we were waiting for the Sub-Committee's report regarding improvement of the working of the Institution and it was hoped that better services would be rendered following this. The Secretary also invited all the members to visit the Headquarters at any time and see for themselves how best all were working even with a limited staff strength. There might be some defects in the system but there was no negligence. Any constructive suggestions from members were welcome.

Shri P. S. Narayana (*M.*) proposed that the Annual Report be adopted and the Audited Accounts be approved. Shri J. G. Bodhe (*M.*) seconded the proposal. It was carried unanimously.

3. The President then asked the Secretary to read the report of the Council on the election for the session 1967-68 of the President and members of the Council. The Secretary, Shri R. N. Banerjee, read as follows:

(i) Maj.-Gen. S. P. Vohra has been elected by the Council as President for the session 1967-68.

(ii) The following members by virtue of their having been elected Chairmen of Local Centres become members of the Council under Bye-law 44:

Andhra Pradesh Centre	O. Thimmaiah
Bihar Centre	A. S. Srivastava
Delhi Centre	G. K. Chandiramani
Gujarat Centre	N. K. Patel
Kerala Centre	S. Rajaraman
Madhya Pradesh Centre	V. D. Gupta
Madras Centre	Brig. M. A. Nayudu
Mysore Centre	I. M. Magdum
Nagpur Centre	V. V. Sardesai
Poona Centre	B. V. Raman
Punjab Centre	Kulbir Singh
Rajasthan Centre	Yadava Mohan
Uttar Pradesh Centre	S. P. Sinha

(iii) Shri N. Subbarao by virtue of his being elected from the Andhra Pradesh Centre becomes member of the Council under Bye-law 44.

(iv) Shri R. N. Joshi by virtue of his being elected from the Bombay Centre becomes member of the Council under Bye-law 44.

(v) Lt.-Col. R. S. Attre by virtue of his being co-opted from the Mechanical Engineering Division becomes member of the Council for 1967-68.

The following Centres have not held their Annual Meetings uptil today and as such the names of their Chairmen are not announced:

(1) Assam Centre

(2) Bengal Centre

(3) Bombay Centre

(4) Jammu & Kashmir Centre

(5) Orissa Centre

4. Shri S. K. Laha (*M*) proposed that Messrs. Price Waterhouse, Peat & Co. be re-appointed Auditors of the Institution for the year 1966-67 on a remuneration of Rs. 6,000 per annum. This was seconded by Shri S. Panchanathan (*M.*). It was carried unanimously

The President then gave farewell address as follows:

'Major General Vohra, Past-Presidents, Members of the Council, Corporate Members, Graduate Members, Student Members, Ladies and Gentlemen.

The retiring President has not much to speak at the Inauguration Meeting nor any general discussion can be raised in that meeting. This is the last chance for the retiring President to meet and talk to all the members and wish them farewell. I have, therefore, great pleasure to do so.

In my Presidential Address I had made a departure by making a declaration of President's policy and I am glad to inform you that during my short term of office, I have implemented all of them except one, namely, Food, for want of help.

I have visited 18 Centres and 19 Sub-Centres of the Institution and addressed all the Student Chapters except Bhilai Sub-Centre and Jammu & Kashmir Centre due to excessive altitude. Over and above these, I have visited many other Student Chapters, inaugurated the same at Dharwar and Mysore, Engineering Colleges at Masulipatam and Ludhiana, Yamuna Project and Brajrajnagar etc.

It was a unique experience, visiting all Centres and Sub-Centres to meet Scientists and eminent Engineers, and the student world and to get myself acquainted with the problems and criticism of the Institution. I have tried to create a great enthusiasm and give a new outlook to the Institution.

I found that some Sub-Centres were working better than the main Centres and this being the case, a Committee has been appointed to discuss the problems of such Sub-Centres and up-grade some of them etc. The Chairmen of some of the Centres do not visit their Sub-Centres at all. The Centres should hold some of their Committee Meetings in their Sub-Centres.

The problems of the Institution are too many to be tackled by a President during his short term of office. Active follow up of policy, decisions and resolutions of the Council are very necessary till the results are achieved. This is a maojr drawback of the management of the Institution with the result that the problems are forgotten and remain unsolved.

Ladies and Gentlemen, I must say that we have been very lucky in having General Vohra as our new President and I have no doubt that he will try to continue my incomplete work and in him we have a very good choice. On behalf of myself and you all I congratulate him.

Our membership and the activities are growing fast. But, I must draw your attention to one important aspect, specially, our developing divisions, such as, Mining and Metallurgy, Electronics and Telecommunication, Chemical and Public Health Engineering Divisions, where the membership is very poor. I have been broadcasting to our Governments and others and even to London Conference that ours is a unique Institution comprising of seven Engineering Divisions under one roof. The activities of these Divisions are also not very encouraging. I have issued a circular to the Chairmen of these developing Divisions to discuss these problems with the members of their Committee and send their recommendations. It is my profund belief, that if this important matter is not taken up very seriously, the Institution will come to grief. I have already informed the Members of the Council that it is time that while selecting the future President we must give a chance to one of the Corporate Members of these Divisions which will be in conformity with the weightage of representation in the Council by us to these Divisions.

Regarding the activities of the Institution during the last year, Ladies and Gentlemen, Members are aware that we submitted a Memorandum for the future of Consulting Engineers in India and gave evidence to Shri Barve.

We submitted a Memorandum with the help of Prof. Govinda Rao to Shri Morarji Desai for Administrative Reforms Commission and the issue of formation of All India Service of Engineers, etc., and gave evidence also.

The National Committee put up a fight with the Government regarding the right of nomination of the Institution's representation in the delegation for the World Power Conference.

The appointment of Civil Administrator and the right of the Chief Engineers to see the Ministers directly without the intervention of the junior I.A.S. Officers, etc., were taken up strongly. I shall follow it up if the President desires.

You are aware of our proposal for representation in the Rajya Sabha as well as nomination in the State Councils. A great enthusiasm has been created amongst our members who are eager to take advantage of the opportunity available now.

In this connection, I am surprised that in spite of clear circular the Centres are sending the names for nomination to the Headquarters and asking them to do the needful further. This is totally wrong. It was made quite clear in the circular that the Chairman of the Local Centre should send their recommendation of members to the Chief Minister for selecting one or all of them and this should be followed up immediately by personal interview. The interview should be based on my letters to the Chief Ministers which they have acknowledged. Now Elections are over and this is a most urgent matter to be followed up by all the Chairmen without a day's delay and report to Headquarters the result of their interview and discussion with the Chief Minister and then only the President can consider any further action, if necessary. I hope this will be borne in mind very clearly and unnecessary correspondence should cease.

I thank the Chairmen of all Centres and Sub-Centres for giving me great welcome and making all arrangements for my visit.

Our Institution is proud of erecting a Statue and honouring the greatest engineer of India, Shri M. Visvesvaraya, the unveiling ceremony of which was done in Hyderabad and the prestige of the Institution has gone up very high. On behalf of all of you, I thank the Hyderabad Government for the great enthusiasm and support given to us. I also thank the Chairman, Col. Attre for the successful function.

I tried for an interview with the Rashtrapati for nomination of our members in the Rajya Sabha. I have been asked to approach the Home Minister for this. I have been asked by the Council to follow this up.

I was extremely pleased with the warmth of welcome given by the Student members wherever I went. I have received the deputations and list of their grievances and action was taken on most of them and a cyclostyle copy of which was sent to all Centres and Sub-Centres. The Students are requested to get in touch with their Centres to get full particulars of this. The Student Chapters may also write directly to Headquarters for this

I would like the members to read my letter to the Prime Minister which was circulated to all Centres and Sub-Centres and to all Council Members and if any of the Corporate Members have not read it I recommended they should read it just to see that our Prime Minister somehow expressed identical views for Scientists and Engineers and by personal contact with her some good results may be achieved. You may also write to the Secretary for a copy. I have written to her what steps she has taken. When she proposes to implement her decision by giving instruction to the States and providing seats in the Rajya Sabha.

Finally, I have tried to be of service to the Institution to the best of my ability, but my work was handicapped considerably for want of an efficient secretariat. A President can do much better output with the help of a first class secretariat. It is not the fault of the Staff but the system which has been prevailing in all these years. A Committee has been appointed specially to look into this and I hope something will come out of it. At present our Institution is working like Government departments instead of a private organisation and with the appointment of a Vice-President considerable improvement will be made. I convey and express my thanks to the Secretary, Deputy Secretary, Heads of Departments and other Staff for their co-operation, etc.

Before I close, I promise that I shall continue to take active interest in the old resolution and try to serve the members of the Institution even after my handing over the charge.

Finally, inspite of my best efforts, if I have not come upto your expectation, I may be forgiven.

Ladies and Gentlemen, Thank you.'

With a vote of thanks to the Chair, the Meeting terminated at 5.00 p m.

Inaugural Session, Saturday, February 25, 1967

The Inaugural Session of the 47th Annual Convention was held in the auditorium of the new building of Bombay Centre of the Institution on Saturday, February 25, 1967, at 11.00 a.m.

Shri S. K. Patil, Union Minister for Railways, inaugurated the Session. He arrived at the Bombay Centre Building at 10.30 a.m. He was received by Shri S. R. Patkar, Mayor of Bombay and Chairman of the Reception Committee, Bombay Centre, and was introduced to Shri B. P. Kapadi, President (1966-67), Major General S. P. Vohra, the President-Elect (1967-68) and Members of the Council for the Session 1967-68.

This was followed by a group photograph taken outside the Bombay Centre building with the Chief Guest, the Mayor, the Past Presidents of the Institution, and the members of the 1967-68 Council.

The party arrived at the venue of the meeting at 10.55 a.m

At the commencement of the Session, a welcome song was sung.

1. Shri S. R. Patkar, Mayor of Bombay and Chairman of the reception Committee of the Bombay Centre, welcomed the delegates to the city of Bombay. Due to throat trouble, Shri Patkar requested Shri J. G. Bodhe, Member of the Reception Committee, to read the full text of the address. Shri Bodhe read as below:

'It is indeed a matter of pride for me as Mayor of Bombay to have selected this Metropolis for the 47th Annual Convention by the Institution of Engineers (India). At the outset, on behalf of the citizens of this great city, I extend to every one of you a warm welcome to our city. The venue, no doubt, has been carefully selected. On account of Bombay's alround importance, the publicity value of holding the Convention of a technical profession has always accentuated. The venue has rightly been selected for another reason because Bombay is being progressively industrialized, giving the lead in many industrial fields. Next to site, is the selection of the Chief Guest, namely, Shri Patil, who is synonymous with modern Bombay's growth and development and its metropolitan and cosmopolitan life. He is the soul of Bombay, inspiring leader, and one who has contributed immensely for the planned development of this great city. Many have seen the services rendered by Shri Patil to the city in various capacities as the B.P.C.C. Chief, the Mayor of Bombay and as Central Minister of Transport, Food and also Railways. Perhaps, there has been no one as sincere and as enthusiastic as Shri Patil is, for maintaining the cosmopolitan character of the city and retaining its coveted title of 'India in miniature' or *Urbs Prima in Indis*. I am not an Engineer but a humble social worker. I will not, therefore, tax you with a sermon on what you should do as engineers. As you know, in our developing economy, engineering in all its aspects—mechanical, automobile, electrical—has to play a vital role. Today, the emphasis has distinctly shifted from 'Public Health' to 'Public Health Engineering' and 'Engineering'. I am sure this Convention will be instrumental in giving a lead in technical ideas and their implementation; and, contribute directly or indirectly to the progress of our economy and development. The country after the present general Elections will have to undertake a more vigorous programme for developing its economy and this engineering meet is of special significance in that context. Every Mayor is concerned with Housing—Cheap Housing—nearly 10 lakhs of people stay on footpath.

With these words, friends, I once again welcome our Chief Guest and all the delegates and members of the Council for the 47th Annual Convention.

Jai Hind!

2. Shri B. P. Kapadia, Retiring President, then requested the Secretary, Shri R. N. Banerjee, to announce the award of prizes by the Council.

Shri Banerjee announced as follows:

(1) The Corps of Engineering Prize

This prize was awarded to Shri C. B. Patel, A.M.I.E., for his paper entitled 'Application of Critical Path Method for Construction Planning', published in the September 1965 issue of the Civil Engineering Division Part of the *Journal*.

(2) The John C. Gammon Prize

This prize was awarded to Shri M. Ramaiah, A.M.I.E., for his paper entitled 'Computer Analysis of Folded Plates by the Method of Transfer Matrices', published in the May 1966 issue of the Civil Engineering Division Part of the *Journal*.

(3) Union Ministry of Irrigation and Power Gold Medal and Cash Award

This prize for irrigation aspects was awarded to Shri K. C. Das, M.I.E., for his paper entitled 'Design of Bidyadharpur Barrage', published in the July 1966 isue of the Civil Engineering Division Part of the *Journal*.

(4) Union Ministry of Irrigation and Power Gold Medal and Cash Award

This prize for power development aspects was awarded to Dr. H. V. Gopalakrishna, M.I.E., for his paper entitled 'Radio Interference Parameter in Design of Extra High Voltage Transmission Line', published in the April 1965 issue of the Electrical Engineering Division Part of the *Journal*.

(5) Sir Thomas Ward Memorial Gold Medal

This prize was awarded to Dr. S. P. Patra, A.M.I.E., Prof. J. K. Chakraborty, A.M.I.E., and Shri S. K. Basu, for their joint paper entitled 'Design and Application of Transistorized Phase Angle Meter' published in the May 1965 issue of the Electronics and Telecommunication Engineering Division Part of the *Journal*.

(6) Pandit Madan Mohan Malaviya Memorial Gold Medal

This prize was awarded to Prof. C. V. Govinda Rao, M.I.E., for his paper entitled 'Effects of Short Circuited Coils on the Performance of Schrage Motor', published in the February 1966 issue of the Electrical Engineering Division Part of the *Journal*.

(7) Dr. Rajendra Prasad Memorial Gold Medal

This prize was awarded to the papers entitled (i) 'Disasters in Mines: a Comparative Study of Occurrence and Prevention' by Shri G. S. Marwaha, M.I.E., published in the November 1965 issue of the Mining and Metallurgy Division Part of the *Journal*, and (ii) 'Current Researches in Coal Mining in Some Western European Countries and Their Application in India Coal Mines' by Shri R. D. Singh, A.M.I.E., published in the March 1966 issue of the Mining and Metallurgy Division Part of the *Journal*.

(8) Sir Ganga Ram Memorial Gold Medal

This prize was awarded to Shri R. Nagarajan, A.M.I.E., for his paper entitled 'Metallizing of Structural Steelwork in Pamban Railway Bridge', published in the February 1966 issue of the Chemical Engineering Division Part of the *Journal*.

(9) The Nawab Zain Yar Jung Bahadur Memorial Gold Medal

This prize was awarded to Shri S. R. Kshirsagar, A.M.I.E., for his paper entitled 'Evaporation Control by Use of Monomolecular Films and Experimental Works Done at Vehar Lake, published in the February 1966 issue of the Public Health Engineering Division Part of the *Journal*.

(10) Institution Prize

An Institution Prize was awarded to Shri O. P. Bishnoi, A.M.I.E., for his paper entitled 'Use of Sewage for Producing More Food, published in the October 1965 issue of the Public Health Engineering Division Part of the *Journal.*

(11) Institution Prize

Another Institution Prize was awarded to Shri G. C. Sharma, M.I.E., for his paper entitled 'Planning of Highway System in Assam' published in the November 1965 issue of the Civil Engineering Division Part of the *Journal.*

(12) Shrimati Saroma Sanyal Memorial Prize

This prize was awarded to Shri R. C. Singh, A.M.I.E., for his paper entitled 'Some Aspects of Economy in Sanitary Plumbing—1: Interrecepting Trap', published in the February 1966 issue of the Public Health Engineering Division Part of the *Journal.*

(13) Chandra Prakash Memorial Prize

This prize was awarded to Shri V. Radhakrishnan and Dr. S. K. Basu, A.M.I.E., for their paper entitled 'Some Experiments in Milling', published in the May 1965 issue of the Mechanical Engineering Division Part of the *Journal,* and to Shri S. Das and Dr. A. Bhattacharyya, A.M.I.E., for their paper entitled 'Analysis of Stagnant Phenomenon in Metal Cutting by High Speed Drop Tool Trigger Mechanism' published in the May 1965 issue of the Mechanical Engineering Division Part of the *Journal.*

The prize were announced by the Secretary, and were given away by the Chief Guest to those present.

3. Shri B. P. Kapadia then installed Major General S. P. Vohra as President for 1967-68. (*Applause*).

4. Major General S. P. Vohra then delivered his Presidential Address (See pages 33 to 46).

5. Shri S. K. Patil, Union Minister for Railways, then delivered the Inaugural Address.

Shri Patil said that the Planning Commission had got to be overhauled to include enough technocrats. He also said that he was always of the view that technocrats should be at the top of the ministries of irrigation, power and so on. Touching on the general elections Shri Patil said the jolt that the Indian democracy got in its infancy would put the country on the path of a healthy democracy.

6. Shri V. Y. Kamat, Chairman of the Organising Committee, Bombay Centre, then proposed a Vote of Thanks to the Chief Guest, Shri S. K. Patil, and other guests present.

7. The Session concluded at 1.00 p.m. with the singing of the National Anthem.

Closing Session, Tuesday, February 28, 1967

The Closing Session was held at 4.30 p.m. on February 28, 1967, in the Bombay Centre Building, Clerk Road, Mahalakshmi, Bombay. The President, Major General S. P. Vohra, was in the Chair.

Commencing the proceedings, the President said that he would request the members who took the Chairs at the meetings of the various Divisions, Groups, Hindi Section, and the Students' Sessions to give brief reports of the proceedings in the respective sessions.

(i) Shri K. K. Nambiar (M.), Chairman of the Civil Engineering Division, who took the Chair during the Paper Meetings in the Division, said that the Civil Engineering Division had a short Session on the 25th afternoon and again a forenoon and afternoon sessions on the 24th February, 1967. The proceedings started with the Chairman's Address. Being the Chairman of the Civil Engineering Division as well as the Chairman of the Roads and Road Transportation Group, the Address was combined into one.

On the Civil Engineering side, he made a brief review of some of the new developments in the various fields of civil engineering—new methods and techniques of construction. Glass fibre reinforced plastics, glass fibre reinforcement for concrete, ferro-cement, polymer cement, epoxies, etc., as well as new techniques in foundation engineering and also industrialised systems of construction—for obtaining large covered areas without any columns or supports, the use of the bridge superstructure type of construction adopted by Prof. Norin to suspend the roof was worthy of special notice.

Coming to Roads and Road Transportation, he reviewed the important developments since his address last year and made particular reference to the report of the Tarlok Singh Committee on Transport Policy and coordination and commented on their recommendations regarding roads and road transport. It was pointed out by him with facts and figures how the Road Transport industry in India was bearing the heaviest taxation in the world and hoped that the Keskar Committee which is going into the question of taxation on Motor Transport would suggest that any further dose of taxation on road transport would be the last straw on the golden eggs. He also pointed out receipt instances of lack of coordination between board development and planning of land use and mentioned the part being played by the Metropolitan Transport Sheds Team in this regard.

Immediately after his Address, the paper entitled 'Design of Reinforced Concrete Grid Floors by Collapse Load Method' by M. Das was discussed.

The lecture of Dr. Soretz of Austria scheduled for 9.30 a.m. on 27th February, 1967, was actually taken up at 12.00 noon. Dr. Soretz could not undertake the journey due to a sudden indisposition and Dr. Helmut Holzenban, his associate, was good enough to come and deliver his speech on 'Ribbed Torsteel for Use as Reinforcement' with a large number of slides. He spoke at length on concrete technology and corrosion of reinforcing steel, the importance of impermeability and adequate cover for reinforcing steel—unlike ordinary m.s. reinforcement the deframed beams and particularly ribbed torsteel made in grades 40, 50, 60 could take very much higher stresses without causing wide cracks on the tension side. A good reinforcement is that which gives minimum value to the largest crack when the steel is stressed to its safe limit. Torsteel prevents slip of band. It is made by cold working and during the process the steel is automaticaly tested—any flans in hot rolling would indicate itself or cause fait use.

The afternoon session on 27th February was opened by Shri K. F. Antia, in absence of Shri Nambiar. Dr. Desayi presented his paper on 'An Investigation for the Prediction of True Ultimate Moment of Reinforced Concrete Beams'. This was followed by the paper by Shri A. K. Jain on 'Hydrodynamic Processes Generated During Earthquakes on Structures Surrounded by Water'.

The President then proposed a Vote of Thanks to Shri K. K. Nambiar for the success of the technical meetings in the Civil Engineering Division. (*Applause*).

(ii) Prof. P. C. Eapen (*M.*), who took the Chair in the Paper Meetings in the Mechanical Engineering Division, could not present the report in person. On his behalf, Lt.-Col. R. S. Attre (*M.*) presented the report. He said that during last year, 40 papers were received out of which 28 were approved for publication and 25 were published in the Mechanical Engineering Division Part of the Journal.

For discussions at the Annual Convention, 20 papers were selected out of which the authors for only 9 of them were present.

After the introductory speech by the Chairman, discussions on the technical papers followed. The attendance was fairly satisfactory and there was lively discussion on most of the papers. Where the authors were not present, the discussions could not be held. Some of the members, however, have given written comments on some papers. As regards the papers that were discussed, most of them dealt with shop tool design.

Some members suggested that the time between the submission of papers and their publication be reduced.

Many student members attended the meetings. As the Journals were not made available for them, they could not effectively participate in the discussions. It is, therefore, suggested that 50 reprints of each paper should be made available at the time of Annual Conventions for reference by student members

The meeting concluded with the request made by the Chairman to the members to contribute more papers on wide range of subjects in mechanical engineering. The Industrial Engineering Group meeting followed which was attended by all the members present for the Mechanical Engineer Division meeting.

The President then proposed a Vote of Thanks to Lt.-Col. R. S. Attre for presenting the report of technical meetings in the Mechanical Engineering Division. (*Applause*).

(iii) In the absence of Prof. H. C. Guha (*M.*), Chairman of the Electrical Engineering Division, who took the Chair during the paper meeting, Prof. M V. Deshpande (*M.*) presented the report. Prof. H. C. Guha's said that a number of papers in the Electrical Engineering Division were presented and discussed. All these papers were selected from the papers that were published during last year. The technical paper meetings were divided into three sessions.

The first session started at 4.00 p.m. on 25th February, 1967. The Chairman conducted this Session. In the beginning he presented his own paper on High Voltage D.C. Transmission' which was very interesting and instructive. After this two papers were presented. One on A Distortion Eliminator-cum-Distortion Analyzer for Power Frequency Mains Supply' by Prof. J. K. Choudhary and D. P. Chakrabarty. The next paper which was discussed the same day was on Recent Developments in Biquadratic Immittance Function Synthesis' by Prof. C. R. Sastri. As Prof. Guha was to leave Bombay on the same day, the rest of the paper meetings were conducted by Prof. M. V. Deshpande.

During the second Session which started at 9.15 a.m. on Monday, 27th February, 1967, following papers were discussed which included one paper from the Nuclear Engineering Division.

1. 'A Review of the Present Status of Solar Energy Utilization' by Shri V. K. Maitreya
2. 'Transient Reversal of Under-rated Low Inertia Single-Phase Squirrel Cage Induction Motors' by Dr. A. K. Das Gupta
3. 'Steady State Heating of Slip Ring Induction Motors under Unbalanced Conditions' by S. Srinivasan
4. 'Application of Equivalence Technique in Linear Graph Theory to Reduction Process in a Power System' by S. Sreenivasan, V. N. Sujeer and K. Thulasiraman
5. 'Application of A Capacitor with the Arno 1:3 Phase Convertor' by T. V. Sreenivasan
6. 'Stability Boundaries Variation due to Delayed Neutron Representation in a Graphite Power Reactor' by Dr. V. R. Sastry and G. S. Deep.
7. 'Grounding Resistance of Straight Horizontal Conductor in Non-Uniform Soil' by B. Thapar

In the third session, most of the papers relating to electrical machines and the power systems were discussed. The session started at 3.15 p.m. on Monday, 27th February, 1967.

1. 'Measurements of Synchronous Machine Power Angle' by S. M. Peeran and B. L. Mathur
2. 'Important Aspects of Integrated Systems Operations' by S. A. Quader
3. 'Solution of the Problem of Peak Demand in the Southern Regional Grid' by S. A. Quader
4. 'A Circuit for the Synthetic Testing of Vaccum Circuit Breaker—Parts 1 and 2' by D. G. Thamaskar
5. 'Equivalent Circuit for a Multi-Winding Transformer' by Dr. R. V. Ratnam and C. K. Sarma

6. 'Studies on Failure of Distribution Transformers' by A. Venkateswara Rao
7. 'Minimum Transit Time and Electricity for City Electric Traction' by Dr. V. K. Jain and W. E. Thompson

The discussion by Prof. C. V. Govinda Rao on the paper contributed by Prof. R. K. Mukherjee on 'Transient Performance of a Started Synchronous Machine Under Unbalanced Load and Fault Conditions—2: Solution of Transients' was also accepted.

In his concluding remarks the Chairman remarked that quality of work that is carried out at various places in India is improving. He thanked those who contributed the papers and also those who took active part in the discussion.

Prof. Deshpande in the end gave a short summary of his latest visit to Japan as delegate to the World Power Conference and of his study tours in Japan.

Methods of forecasting of loads are being developed by the use of econometric models. Prediction of load even by hours is being developed to the help to the system engineer, to feed in correct information to the computer which in turn can control load sharing between various stations and units in the system.

There is progress in research for development of fast breeder reactors and it is expected that in next 20 years, the large power systems in the world would use fast breeder reactor stations as base load stations of the system load curve supplemented by thermal reactor stations while hydro-stations will be mainly designed and used as peak load stations.

The industries in Japan have advanced immensely and are producing quality products to specifications—straight from the transistors to giant generators and turbines.

The latest research problems are being handled in various universities such as development of materials, processes and techniques in electrical engineering field; research ' in plasma physics controls, magnetohydrodynamies, railway electrifications, etc., and computers are profusely used for solution of non-linear problems.

In Japan, it was found that there is vast development not only in electrical industries but all types of industries such as steelworks, shipbuilding, large construction works, bridges, express highways, earthquake proof buildings, fertilizer factories, agricultural implements in addition to transistorized equipment, cameras, etc. With devoted and planned work, industrious people of Japan have already captured world markets in various countries in various types of engineering goods.

A lesson from Japan would be 'national outlook', 'devotion to duty', 'planned work and time' to obtain speedy results.

The President then proposed a Vote of Thanks to Prof. M. V. Deshpande and directed to convey a Vote of Thanks to Prof. H. C. Guha for the success of the paper meeting in his Division.

(iv) In the absence of Brig. M. K. Rao (*M.*), Chairman, Electronics and Tele-communication Engineering Division, Sarvashri Shanti Swaroop and C. K. Menon (*A.M.*) took Chairs on 25th and 27th February, 1967.

During the first session the papers presented were (i) 'Fluctuation Theory of Luminance Discrimination for the Light Adapted Eye and Its Particular Application on T.V. Case', and (ii) Gray Scale Properties of the Eye'.

Shri P. S. Moharir (*Non-member*) read the papers which were followed by discussion.

On request of Chairman, Shri V. K. Menon gave a talk on 'Activities of Electronics Division in Bhaba Atomic Research Centre' previously known as Atomic Energy Establishment. During the talk Major General Vohra, President of the Institution, visited the Session and took active part in the discussion. He was present for more than 45 minutes. He stressed the need of creating more interest in the field of electronics as applied to defence and medicine. He also stressed the need of having a unified institution rather than the present trend of having a number of institutions. He assured the members that more efforts will be made by the Institution and he will look into personally to develop the activities of the Electronics and Telecommunication Engineering Division.

During the second session Shri K. G. Nadar (*A.M.*) read the paper 'Single Transistor Voltage Controlled Oscillator and Its Application'. There were discussions on the paper which were followed by talks on (1) 'Electronics and Signalling in Railways' by Shri F. X. Vigas (*A.M.*), and (2) 'Electronics to the aid of Industry' by V. K. Menon (*A.M.*)

This lead to discussions and Shri B. R. Naik (*M.*), enquired about the availability of electronic equipment to measure the effect of stress and fatigue on steel used in prestressed concrete. He further sugested that electronic engineers should help their civil brothers in assessing the properties of material avoiding damage to the material or construction.

Attendence was very very poor. The room provided for the Divisional meeting was very bad with barely any facilities conducive of attending what to say of good presentation of or discussions on the paper.

The President then proposed a Vote of Thanks to Shri V. K. Menon (*A.M.*) and directed to convey a Vote of Thanks to Brig. M. K. Rao (*M.*), and Shri Shanti Swaroop for the success of the technical paper meeting in the Division. (*Applause*)

(v) Dr. G. P. Chatterjee (*M.*), Chairman of the Mining and Metallurgy Division, who took the Chair during the paper meetings of the Division said that the following papers were presented during the technical meeting, of the Mining and Metallurgy Division.

1. 'Bimetallic Welding' by Dr. Bhanu Prakash
2. 'Current Research in Coal Mining' by Prof. R D Singh

3. 'Recovery of Lead and Zinc from Lead Blast Furnace Slag' by Prof. S. Sarkar
4. 'Electrification of Open Cast Mines' by S. G. Vyas

The paper on 'Recovery of Lead and Zinc from Lead Blast Furnace Slag' by Prof. Sarkar evoked considerable interest because of shortage of lead and zinc in the country and the foreign exchange involved on that account. Lively discussion followed on the other papers.

The Chairman delivered an Address dwelling on the topic of 'Material Science and Engineering'—Its Importance in the present stage of development of the country both with regard to the proper utilization of raw materials and other resources available in the country for the development of new materials from indigenous resources and in minimising foreign exchange.

A Seminar was arranged by the Division during its Technical Paper Meeting on 'Material Science and Engineering', in which the following papers were presented.

1. 'Material Science for Engineers' by Prof. N. S. Govinda Rao
2. 'Dislocation and Strength of Metals' by Prof. Raja Rao
3. 'Evaluation of Soft Magnetic Materials' by Prof. P. R. Khangaonkar and Dr. V. M. Dokras

After all the technical papers and the papers for the Symposium were presented, very useful and lively discussions followed. It was resolved that on the basis of the materials presented, suitable recommendation made to the President, Major General S. P. Vohra, for onward transmission to the Planning Commission/Government.

Very interesting and informative contributions were also made during the Symposium by Shri S. Basu, Shri P. S. Narayana, and others. After some lively discussion on the importance of the subject, it was unanimously felt that a Symposium on 'Material Science and Engineering' on a larger scale should be organized during the next Annual Convention. As material science and technology have common frontiers, practically with all field of engineering profession, it was stressed that in such a Symposium all the Divisions be invited to participate and the proceedings of this symposium will no doubt be a valuable reference material for all concerned.

Quite some amount of brisk activity is going on in other countries regarding material science and engineering, and it was strongly felt that the Institution of Engineers (India) should take a lead in this country, not only by compiling materials and useful information on the subject with particular reference to indigenous resources but also including a paper in the Institution examinations. Many universities and higher institutions of learning in almost all advanced countries as well as the same of the higher institutes of learning in this country have incorporated a compulsory paper on 'Material Science and Technology' in the curricula of studies and it was the unanimous recommendation that the Institution should also do so and take a lead in this matter. Thus three important proposals were unanimously recommended on the basis of the deliberations of this Division.

The Chairman of the Mining and Metallurgy Division desired to make suitable recommendations to the President with regard to (i) the utilization of resources and saving of foreign exchange for onward transmission to the Planning Commission/Government; (ii) the holding of a Symposium on 'Material Science and Technology' on a larger scale on the occasion of the next Annual General Meeting in collaboration with all the Divisions of the Institution; (iii) (a) the incorporation of a paper on Material Science and Engineering in the Institution examinations; and (b) explore the possibility of taking a lead in this country for incorporating an examination on 'Materials Science and Engineering'.

The President then proposed a Vote of Thanks to Dr. G. P. Chatterjee (*M.*), for the successful conduct of the technical meetings in the Mining and Metallurgy Division (*Applause*).

(vi) At the request of Shri K. N. Rohatgi (*M.*), Chairman, Public Health Engineering Division, who took the Chair in the Proceedings of the Public Health Engineering Division meeting Prof. S. J. Arccivala (*M.*), presented the report.

The Public Health Engineering Division had its first meeting on Saturday, 25th February, 1967, and then again on Monday, the 27th February, 1967, at which papers presented by the members were discussed. This meeting was attended by as many as 65 engineers with Shri K. N. Rohatgi, Chairman of the Division, presiding.

During the meeting, it was discussed and unanimously agreed that vigorous step should be taken to increase the membership of the Division, which is at present a little over 200 to increase to the minimum target figure of 500 in as short time as possible. In this connection, members felt that since most of the Public Health Engineers also had keen interest in the Civil Engineering Division, they should be able to receive the Journals and participate in technical activities of at least two Divisions of their choice. They could, however, continue to have voting rights in only one Division. The Public Health Engineering Division unanimously resolved that the Council be moved to approve each Corporate Member being allowed to join more than one Division for purposes of Journals and technical activities—at least two without any extra payment, as many members though Public Health Engineers are reluctant to join Public Health Engineering Division, if they have to leave Civil Engineering Division or Mechanical Engineering Division in doing so. For voting purposes each member would continue to be attached to one Division.

The Public Health Engineering Division also discussed the need for enlarging its Division Board and resolved as under:

Resolved that the Public Health Engineering Division Board which is one of the four developing Divisions should have a minimum membership of 7 by allowing co-option of Public Health Engineers from the Committees of various Local Centres. While doing so care should be taken to see that regions remaining unrepresented by normal elections are given due preference. Special invitees may continue to be invited as and when necessary.

The Public Health Engineering Division also resolved to continue publishing its Newsletter, which was very useful in disseminating latest information to the members from time to time, so as to popularise and encourage the excellent work being done in many parts of India in this field

The meeting continued with presentation of the 16 technical papers published during the year, out of which only the following five papers whose authors were present, were taken up for discussion. The discussions following each of the papers were quite lively and judging from this as well as the fact that the Division had a high attendance, the Session could be recorded as a very successful one.

1. 'Evaporation Control by use of Monomolecular Films and experimental Work Done at Vehar Lake' by Shri Kanga on behalf of Shri S. R. Kshirsagar
2. 'Hydrogen Sulphide in Concrete Sewers and Digesters' by Dr. Mohan Rao
3. 'Oxidation Ponds at Vijayawada' by Y. S. Murti
4. 'Sewage Purification Works for Small Quantities of Domestic Sewage and Industrial Wastes' by C. J. Shah
5. 'Tapping Sub-Surface Water of Nehisagar River for Gujarat Refinery Water Supply by a French Method of a Well with Radials'.

The President then proposed a Vote of Thanks to Prof. S. J. Arcievalla and to Shri K. N. Rohatgi (*M.*), for the success of the paper meeting in the Division.

(vii) Dr. V. M. Dokras (*M.*), Chairman of the Chemical Engineering Division, who took the Chair in the paper meetings of the Division could not present his report in person. The Secretary read the report on his behalf.

The technical session in this Division was held on February 25, 1967. It started with the Chairman's Address, which stressed the necessity of the Institution and its Divisions to actively participate in the development plans of the country by providing authoritative and complete technical reports for consideration. This was followed by the discussion of the three following papers, presented by the authors.

1. 'Coke Oven Gas Feedstock for the Manufacture of Ammonia with Special Reference to the Proposed Talcher Industrial Complex Project' by D. Panigrahi and Dr. H. P. Misra
2. 'Metallizing of Structural Steelwork and Its Application in Pamban Railway Bridge' by Shri R. Nagarajan
3. 'Need for Gas Turbine Power Plants in a Refinery' by Shri S. K. Goyal

There was considerable discussion after the papers were presented. The Session was fairly well attended.

(viii) Shri K. F. Antia (*M.*), Chairman of the Prestressed Concrete Group, who took the Chair in the paper meetings of the Group said that the meeting was held on the forenoon of Monday, February, 27, 1966. It started with his Address. He commended the work done by F.I.P.

The following papers were read in the afternoon Session.

1. 'Precast Prestressed Concrete Trussed Girder' by Dr. K. D. Banerjee and projected some slides which showed the methods of loading during tests.
2. 'Design Aspects and Manufacture of Prestressed Concrete Girders 40-ft. Span on the N. E. Railway'.

He stressed the advantages of precast prestressed girders and stressed that the maintenance cost of prestressed girder is almost negligible compared to steel girder and were cheaper.

The President then proposed a Vote of Thanks to Shri K. F. Anita (*M.*) for the success of the technical meetings in his Group.

(ix) Shri N. N. Purandare (*M.*)took the Chair in the absence of Prof. G. S. Ramaswamy (*M.*) Chairman of the Shell Structures Group, apologized to the delegates on behalf of Shri Ramaswamy, who could not attend this Convention due to pressure of work. The Session started on the morning of 27th February, 1967, and the following papers were presented.

1. 'A Survey of Numerical Procedures for the Analysis of Plate and Shell Problems' by Dr. J. R. Desai
2. 'Analysis of the Elastic Cylindrical Shells by Finite Elements Method' by Shri S. Chakrabarti was read by Shri A. N. Purandare, in the absence of the author.
3. 'Circular Plates Carrying Linearly Varying Load' by Dr. A. S. Arya, presented with aid of sketches.

The President then proposed a Vote of Thanks to Shri N. N. Purandare (*M.*), and desired a Vote of Thanks be conveyed to Prof. G. S. Ramaswamy (*M.*), for the success of technical paper meeting in the Group. (*Applause*).

(x) Shri D. N. Chopra, Chairman of the Railway Engineering Group, who took the Chair in the technical session of the Group, could not present the report in person. The Secretary read the report on his behalf.

The Session started on the morning of 27th February, 1967. First the Chairman delivered an Address. In his Address, Shri Chopra mentioned about the rising cost of running of Indian Railways. He said that modernization of Railway system is closely linked with electrification. He stressed the need of modernization of signalling and interlocking of sophisticated telecommunications for better efficiency and safety. He said that aim of railway is to provide faster, safer and more comfortable train services to railway users.

In the afternoon session Shri R. Nagarajan presented his paper 'Some Aspects in the Design of Plate Girders for Curved Railway Tracks'. He mentioned about variation of bending moments in the inner and outer girders in bridges on curves. He said that in hill sections it is not possible to avoid curves on bridges.

(xi) Shri K. K. Nambiar (*M.*), Chairman, Roads and Road Transportation Group, who took the Chair in the paper meetings of the Group said that the meeting was held on 27th February, 1967, and the paper entitled 'Urban

Transportation' by Shri P. G. Patankar was discussed. He explained the various methods of transportation system and also compared the costs, etc. He thought that the underground system is best solution for Bombay City. There was good response to his paper and all questions were answered by Shri Patankar suitably. Shri R. N. Joshi, who opened the discussion gave his suggestions to tackle the mass transport problem in Bombay City and commented on Smith's proposals.

The President then proposed a Vote of Thanks to Shri K. K. Nambiar (*M.*), for the success of technical paper meeting in the Group. (*Applause*).

(xii) Shri R. M. Patre (*M.*), Chairman of the Industrial Engineering Group, who took the Chair in the paper meetings could not present the report in person. On his behalf, Lt.-Col. R. S. Attre presented his report. He said that the technical paper meeting was held on 27th February, 1967. The number of papers selected for discussions were five, out of which four authors were present.

In his Chairman's Address, Shri Patre laid greater emphasis on industrial engineers as large number of engineers in addition to their technical duties are taking over Industrial management. In his speech he differentiated between managing and doing which served as a guidance to young Industrial Engineers.

After the introductory speech, papers were read and lively discussions on them followed.

The Chairman remarked that more time should be allotted to the Industrial Engineering Group discussions. He also suggested that both Mechanical and Engineering Divisions should be invited to participate in Industrial Engineering Group discussions. He further suggested that the discussion be held in the morning Session.

The President then proposed a Vote of Thanks to Lt.-Col. R. S. Attre (*M.*) for presenting the report of technical session in the Industrial Engineering Group.

(xiii) Shri S. Basu (*M.*), Chairman of the Marine Engineering and Shipbuilding Group, who took the Chair in the technical paper meetings delivered his Address on 28th February, 1967.

After his Address, he said that no papers suitable for publication or discussion were received during the year. Only four members who could be classed within the Group attended the Convention.

A Symposium on 'Materials Science in Engineering' arranged by Shri G. P. Chatterjee, Chairman of the Mining and Metallurgy Division was attended and a fruitful discussion resulted in a resolution for the introduction of this subject in the education of students.

A discussion was held among the members of the Group to consider the ways and means of convincing other members of the importance of contributing technical papers to the Group, and of attracting non-members to join this Group as members.

The qualifications necessary for recognition were reviewed.

The President proposed a Vote of Thanks to Shri S. Basu (*M.*), for the success of the technical meetings in the Marine Engineering and Shipbuilding Group. (*Applause*).

(xiv) Lt.-Col. R. S. Attre (*M.*), who took the Chair in the Students' Session (General and Technical) said that the sessions were held as scheduled from 2.30 p.m. on February 26, 1967, in the Auditorium of the Bombay Centre of the Institution. The Students' Session was conducted in two parts ; firstly, the Technical Session, and secondly, the General Session.

Since the timing of the Students' Session particularly in the Technical Session coincided with the Council Meeting, no Council Members could be present in the Students' Session, much against the wish of many of them. It is once again strongly suggested that in future no other programme be fixed during the time allotted for the Students' Session. This will enable the Council and other Corporate Members to attend the Students' Session and thus help them to guide and advise the Student Members.

In the Technical Session this year eleven papers were presented by the Student Members. We were privileged to have Maj-Gen. N. Sen Gupta, Commander, Technical Group of the Indian Army, as the Chief Judge. Prof. B. K. Mallick, Dr. N. S. Nandeeswaraya, Shri N. N. Purandare and Dr. R. Pitchai were the Judges. The papers were of high average standard and lively discussed by the authors as well as the audience.

As declared by the Chief Judge the first three papers, in order to merit were presented by (i) Shri G. G. Kelkar for his paper 'Analytical Study of Strength of Concrete and Its Relation to the Various Ratios of Absolute Volumes of Cement, Water and Aggregate' ; (ii) Shri B. Nagaraja Rao for his paper 'Operational Amplifiers—Their Use in Analog Computers' (iii) Shri R. N. Reddy for his paper 'Optimum Pressure in a Two-Stage Reciprocating Compressor with different Indices of Compression'; and (iv) Shri K. S. Vazirani for his paper 'The Factors Influencing the Selection of Cutting Fluids for Machine Tools'. The paper by Shri K. S. Vazirani was selected as fourth best paper on request of Shri M. C. Bhansali, who very kindly announced a fourth prize. These prizes will be presented by the President.

In this connection, Col. Attre informed the august gathering that Shri R. S. Narayana, a very senior member of the Institution from Mysore Centre, was greatly pleased with the proceedings of the Technical Session and to encourage Student Members, he has very kindly offered seven prizes for the best papers in the seven Divisions of the Institution with effect from next year, subject, of course, to the approval of the Council.

The General Session commenced, as scheduled, from 5.00 p.m. Initially the discussions were mainly regarding the points submitted by the Student Members at the Patna Session, last year. Then the Student Members present were invited to speak on relvant matters which they wanted to bring to the notice of the Headquarters, Council and the President.

The Students' Session also had the proud privilege of having the President General Vohra amidst them. The arrival of the President was greeted with prolonged and loud applause. The President also addressed the Student Members and advised them that the major effort should be to pass the examinations of the Institution. The Institution on its part will try and help them in achieving their aim. He said that efforts will be made to create organizations to give lectures and arrange coaching classes for Students by various Centres and Sub-Centres. The Local Centres will also be asked to approach the State Governments to help them. He also promised to help the Students by increasing the library grants so that they could benefit more by borrowing books from them. However, the depot cannot be waived at present.

The President then paid his tribute to the Chairman of the Student Members and stated that last year the President and the Council had selected a right person for the job because some one who knows the Students' problem and is young and active should be entrusted with such a work.

The President desired that the problems of the Student Members should be analyzed and their suggestions put up to him by Shri D. K. Chosh, the Deputy Secretary, present in the meeting.

The President also promised that he would try to get more funds allotted for the activities and Welfare of the Students.

The Students were also privileged to have Shri B. P. Kapadia, the immediate Past-President, and a very great campaigner of the Students' cause amidst them. We were also blessed by the presence of Shri N. S. Govinda Rao, the Past-President. Both the Past-Presidents also addressed the Students and exhorted them to raise their standard, in turn, that of the Institution. Shri Kapadia further stated that we have a lot to do for the Students but they must make all efforts to pass their examinations soon and not take very long time. The speeches of Shri B. P. Kapadia and Prof. N. S. Govinda Rao were listened by the Students' rapt attention.

The Chairman further said that the Students would definitely try their best to achieve their goals as outlined by the Presidents and two immediate Past-Presidents.

The General Session came to a close at 8.20 p.m., only when the Chairman ascertained that there were no other points from the Student Members, just in time to be able to attend the Annual Banquet, ten minutes later.

He also thanked the Bombay Centre for arranging the Students' Session in a good place. However, he would like to suggest that in future, more time should be given for the Students' Session. This year it took about six hours to complete the entire deliberations.

The suggestions and problems of the Students have been noted down by Shri D. K. Ghosh, the Deputy Secretary. He requested that all those should be progressed and all Centres and Student Chapters informed of the decisions arrived at in the next few months. Mainly the problems of the Student Members pertained to late receipt of replies from the Headquarters, request for reduction of Examination fees in some form, recognition of their qualification by various Government Departments, facilities for their further education and betterment of their prospects, as well as better supply of Examination application forms and more grants for the various Students' Chapters and libraries.

He also acknowledged the great help, guidance and advice given to him by the Council and Senior Corporate Members during the year. It was very heartening to see so many senior members present even at the lengthy Students' Sessions. He was convinced that friends, philosophers and guides in the form of the President, General Vohra, Past-Presidents like Shri B. P. Kapadia, Shri N. S. Govinda Rao, Shri Dildar Husain, Shri N. V. Modak, etc., Council Members and Senior members like Shri Narayana, Dr. Visvesvaraya, Shri Desai, Dr. G. P. Chatterjee and many others that the activities of the Student Members will increase day by day and their requests will be given sympathetic and favourable considerations and they will enable the Student Members to raise their standard so that the banner of the Institution is raised higher and higher.

The President proposed a Vote of Thanks to Lt.-Col. R. S. Attre (M.) for the successful conduct of the Technical and General Sessions of the Students' Session during the Convention. (*Applause*).

(xv) The technical session of the Hindi Section was held on Saturday, Ferburay 25, 1967, at 4.30 p.m., in the open lawn outside the auditorium. As Shri Brij Mohan Lal *(M.)*, Adviser, Hindi Section, could not attend the Convention due to ill-health, the meeting was held under the chairmanship of Shri J. P. Mital *(M.)*, a member of the Council. After a brief introduction by Shri Mital, the written address of the Adviser, was read by Shri Vishwambhar Prasad *(A.M.)*, and copies were distributed to the audience.

In his written address Shri Brij Mohan Lal expressed his satisfaction for receiving a great number of papers during the previous year. Some papers were of a high standard and were based on original researches made by the authors. He exhorted the members to write more papers in Hindi without hesitation if they could not find suitable Hindi equivalents for English technical terms as it was for the editor to substitute suitable Hindi word. He wanted the authors to express their thoughts in simple Hindi which could be easily understood.

The paper on 'Sir Lakshmi Pati Misra' was then presented by Shri Vishwambhar Prasad. The paper having already been published in the *Journal*, only the salient features were brought out. The Chairman, Shri Mital, thereafter related some reminiscences of his personal contact with Sir Lakshmi Pati which added to the broad vision of the great Engineer as brought out in the paper.

Dr. G. P. Chatterjee *(M.)* was then requested to introduce his paper on 'Study of Steel by the Electro Microprobe'. Having first requested to be apoligised for not being able to speak good Hindi, Dr. Chatterjee spoke and explained the subject of his paper in fluent and simple Hindi. About the utility of this rare instrument, he said, that the purchase of the instrument at a cost of a lakh of rupees has already resulted in a saving of some fourteen lakhs of rupees. He also disclosed that this was the first paper written on the subject not only in Hindi but in any language. On inviting discussion, Shri Vishwambhar Prasad said that the instrument is as complicated as it is delicate, and it is not possible for every one to understand how it works. One has therefore to be contented with only some information as to what its functions are. Dr. Chatterjee threw some more light on the use of the electromichroprobe.

The third paper, *viz.*, the one on rigid runway pavements was then introduced by the author, Shri Vishwambhar Prasad, who explained in brief the comparative merits and demerits of rigid pavements as against the usual and more common flexible bituminous pavements. Various types of joints, their necessity and construction was then detailed by him in short, which was followed by a lively and interesting discussion.

The meeting was poorly attended as it was not properly notified in the programme and even its venue was not decided till the last moment. It is therefore desirable that the meeting is properly notified in the programme published in the *Bulletin* and its venue indicated on notice boards.

(xvi) The President, Major General S. P. Vohra, then concluded the 47th Annual Convention by delivering a brief speech as below.

'I have now a very pleasant duty of extending our sincere and warm thanks to the Bombay Centre for acting as hosts on the occasion of the 47th Annual Convention and for their kind and generous hospitality during the last few days which we have thoroughly enjoyed and will be remembering for days to come. Our appreciation has to be given in double measures particularly as the arrangements have been very liberal, thorough and of extremely high standard. I also understand that this year registration of Corporate, Graduate and Student Members from all over the country has been much higher than the previous years. I will like to make special mention about the remarkable progress made in the construction of the new Institution Building of the Bombay Local Centre which has been due to the untiring efforts of the Local Centre which has been due to the untiring efforts of the Local Centre Committee. But for this new building, it would have been difficult to arrange for the various sessions held during this Convention in one place, and attain such a high standard for this Convention.

In particular I wish to mention the names of Shri S. R. Patkar, Mayor of Bombay and the Chairman of the Reception Committee, Shri V. Y. Kamat, Retiring Chairman of the Bombay Centre and the Chairman of the Organising Committee who invited us to Bombay for this Convention and Shri P. G. Patankar, Honorary Secretary of the Bombay Centre as well as the Organising Secretary of the 47th Annual Convention. But for their unstinting and untiring efforts, enthusiasm and zeal, this Convention could not have been such a great success.

In addition I will also like to mention the names of Shri K. F. Antia, Shri J. G. Bodhe and Major R. P. E. Vazifder, the new Chairman of the Bombay Centre and members of the Organizing Committee who have taken great pain to make this Convention a success.

It will be incorrect on my part as not to convey our thanks to the Convenors and members of the various Sub-Committees of the Bombay Centre as well as the staff who are responsible for the various arrangements which have contributed towards success of this Convention.

I would also like to convey my personal thanks, on behalf of my wife, and on behalf of all the delegates attending this Convention and their ladies to members responsible for arrange such wonderful variety entertainment shows, in particular the Marathi Play—Mandarmala—which all of us have thoroughly enjoyed.

Our special thanks are also due to Mrs. Vazifder and Mrs. Bhat, Convenors and members of the Ladies' Committee of the Bombay Centre who have so kindly and generously looked after our lady wives, conducted them around the beautiful city of Bombay, took them on conducted shopping tours and even went to the extent of arranging a special Fashion Show.

I would also to convey my personal thanks, on behalf of the Institution of Engineers (India) and all the delegates, to the following industrial firms for the lavish way we have been entertained by delicious Lunches and At Homes during this Convention:

(i) Messrs. Larsen & Toubro Ltd., (ii) Messrs. Patel Engineering Co. Ltd., (iii) Messrs. Kamani Metals and Alloys Ltd., (iv) Messrs. Associated Cement Cos. Ltd., (v) Messrs. Asbestos Cement Co., Ltd., and (vi) Messrs. Sahu Cement Service.

There are large number of other industrial organizations who have contributed a great deal and accorded cooperation and assistance in all possible ways to make this Annual Convention a great success. I will take this opportunity to thank them as well. Some of the names are: (i) Messrs. Kirloskar Oil Engines Ltd., (ii) Messrs. Guest, Keen, Williams, Ltd., (iii) Messrs. Advani-Oerlikon Electrodes (Private) Ltd., (iv) Messrs. Bhor Industries (Private) Ltd., (v) Messrs. Gamlin (Private) Ltd., (vi) Messrs. Foundation Corporation India Ltd., (vii) Messrs. Britannia Biscuits (Private) Ltd., (viii) Messrs. Bombay Dyeing (Private) Ltd., (ix) Messrs. Hard Castle Ward (Private) Ltd., (x) Messrs. Century Rayon (Private) Ltd., (xi) Messrs. Voltas (Private) Ltd., (xii) Messrs. Tata Oil Mills (Private) Ltd., (xiii) Messrs. Dodsal (Private) Ltd., (xiv) Messrs. Ponds Cream Ltd., (xv) Messrs. Radio Hazarat (Private) Ltd., and (xvi) Messrs. Excel Engineering Co. (Private) Ltd.

My special thanks are also due to Indian Posts and Telegraphs Department who very kindly established a Post Office and a Telephone Call Booth for the convenience of the delegates. State Transport undertakings and Bombay Electricity are also due special thanks for providing power connection and arranging special buses for the delegates respectively.

I must also thank the heads of the following institutions and industrial firms who have very kindly arranged to conduct all the delegates around their establishments:

(a) Indian Institute of Technology, Powai, (b) Messrs. Premier Automobiles Ltd., Kurla, (c) Messrs. Larsen & Toubro Ltd., Powai, (d) Messrs. Crompton Greaves Ltd., Bhandup, (e) Atomic Energy Establishment, Bombay, (f) Esso Refinery and (g) Tata Thermal Power Station.

I am particularly grateful to the Management of the 'Engineering Times' of Calcutta for their spontaneous offer of special supplement of their issue on the occasion of our Annual Convention and also covering the entire function during the last five days and giving the Institution a proper presentation to the public.

I will also like to express my sincere thanks to the Indian Medical Association and the Executive Engineer, Presidency Division, Government of Maharashtra for allowing us to use their premises without which it would not have been possible for us to hold the various meetings and sessions simultaneously.

But for the various industrial firms, undertakings, establishments, institutions and organizations mentioned above who have generously contributed and accorded all possible assistance, it would not have been possible to make this Annual Convention such a great success. It is quite natural that professional bodies like ours, have to seek patronage and assistance off and on from the various Industrial Undertakings, with whom we engineers are closely connected or rather form part of them.

Outstation tours will be commencing this evening and I will take this opportunity to extend my sincere thanks to the railway authorities, State Transport authorities and our friends in the various organizations at Baroda, Tarapur, Koyna, Poona and Aurangabad, without whose help and enterprise it would not have been possible to arrange these outstation tours. I am sure delegates will have a comfortable journey and will thoroughly enjoy the outstation tours during the next few days.

In the end let me thank all the delegates and their lady wives, who by attending in large numbers have added grace to this 47th Annual Convention.'

After the speech, Shri J. G. Bodhe (*M.*) made an appeal to members requesting their help for the compilation of the 'History of Bharatiya Technology'. Shri V. Y. Kamat, Chairman, Organising Committee of the Bombay Centre, then proposed a vote of thanks. The session concluded at 6.00 p.m.

Social and other functions

Annual Dinner

The Forty-Seventh Annual Dinner of the Institution was held on Sunday, February 26, 1967, at the Shamiana in the campus of the Indian Medical Association building. Dr. P. B. Gajendragadkar, *Vice-Chancellor* of the University of Bombay, was the Chief Guest. Many guests and over 1,000 members attended the Dinner.

After the Dinner, the President, Major General S. P. Vohra, requested the guests and members to rise and drink a Toast to the President and the Republic of India.

The President also proposed a Toast to the Chief Guest and Dr. Gajendragadkar replied to the Toast.

Major R. P. E. Vazifdar proposed a Toast to 'Our Guests'. Shri L. M. Nadkarni, I.C.S., replied to the Toast.

Captain K. K. Datey then proposed a Toast to 'The Institution of Engineers (India)'.

Shri B. P. Kapadia replied to the Toast.

Shri V. Y. Kamat proposed a Toast to 'Our Ladies.

Sm. Krisha Vohra replied to the Toast.

Lunch by Larsen & Toubro Ltd.

Larsen & Toubro Ltd., Bombay, gave a lunch to the delegates on Saturday, February 25, 1967.

Lunch by Patel Engineering Co., Ltd.

Patel Engineering Co., Ltd., Bombay, gave a lunch to the delegates on Sunday, February 26, 1967.

Variety Entertainments

A Marathi drama *Mandarmala* was staged at the Birla Matushri Sabhagar on Saturday, February 25, 1967 at 8.00 p.m. for the delegates. Two more variety entertainments were also arranged by the Bombay Centre on February 26 and 27, 1967.

Lunch by Kamani Engineering Corporation, Ltd.

Kamani Engineering Corporation Ltd., Bombay, gave a lunch to delegates on Monday, February 27, 1967.

Lunch by Associated Cement Co., Ltd.

Associated Cement Co., Ltd., Bombay, gave a lunch to delegates on Tuesday, February 28, 1967.

The Tenth Sir Mokshagundam Visvesvaraya Lecture

Shri S. B. Joshi, Past President, delivered the Tenth Sir M. Visvesvaraya Lecture. The subject of the Lecture was 'Bridge Engineering in India.

The First Nidhu Bhusan Memorial Lecture

Prof. N. S. Govinda Rao, Past-President, delivered the First Nidhu Bhusan Memorial Lecture on 'Technology—a World Unifying Force' on Monday, February 27, 1967, at 2.15 p.m.

Popular Lectures

Shri S. R. Bhagwat delivered a Lecture on 'Conservation of Rain-Water in Underground Reservoir Before Any Flow Begins to Move Down above Ground' on Tuesday, February 28, 1967, and Shri J. G. Bodhe delivered a lecture on 'World and India in 2000 A.D.' on the same day.

Minutes of the Special General Meeting of Corporate Members held in Bombay on Friday, February 24, 1967

A Special General Meeting of Corporate Members of the Institution was held in the building of the Bombay Centre of the Institution, Clerk Road, Mahalakshmi, Bombay, on Friday, February 24, 1967, at 3.15 p.m., for the purpose stated in the Notice of the Meeting dated January 14, 1967, printed in the January 1967 issue of the *Bulletin*.

One hundred and thirty-six Corporate Members attended the Meeting, and it was presided over by the President, Shri B. P. Kapadia.

The Notice of the Meeting was read out by the Secretary.

It was proposed that the Regulation 64 be amended to read as 'A Directory of the Institution shall be published once in every three years'.

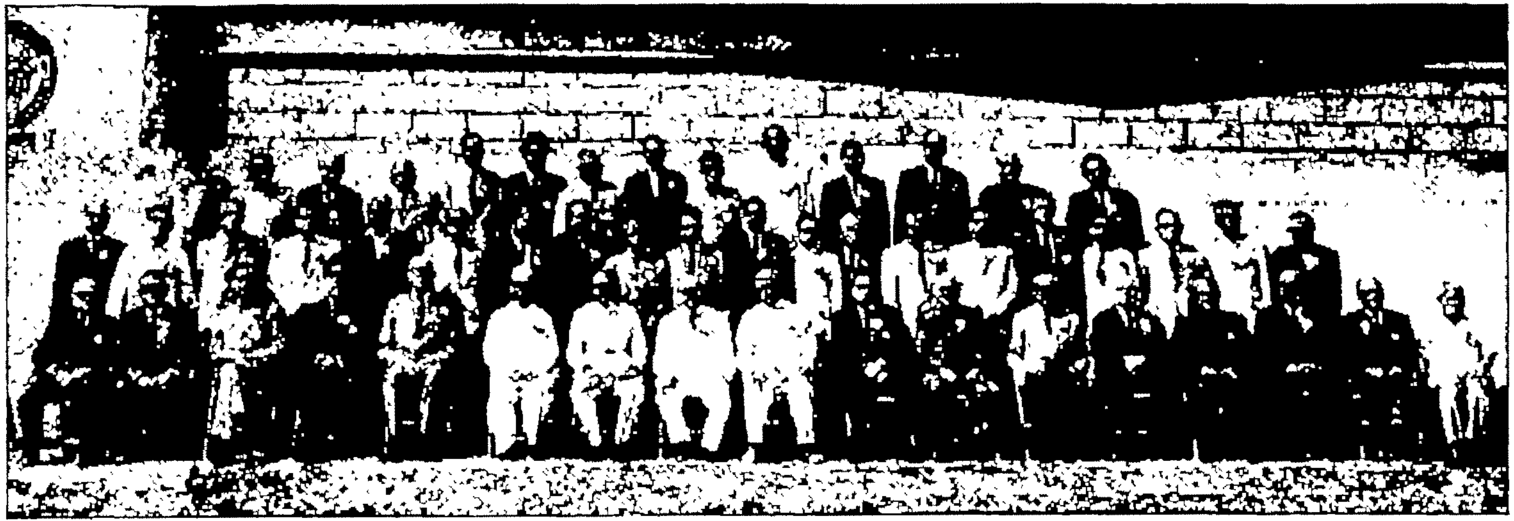
At this stage, Shri J. G. Bodhe (*M.*) proposed that in addition to publishing a full Directory of the Institution once in every three years, a supplementary of additions or deletions should be published each year. Shri K. K. Nambiar (*M.*) and Prof. H. C. Guha (*M.*) seconded the proposal of Shri Bodhe.

After discussion, finally it was unanimously *Resolved* that the Regulation 64 be amended to read as follows:

'A Directory of the Institution shall be published once in every three years. Each year a Supplement shall also be published showing the additions, deletions and transfers in the membership.'

With a vote of thanks to the Chair, the meeting terminated at 3.25 p.m.

47TH ANNUAL GENERAL MEETING, BOMBAY, FEBRUARY 1967

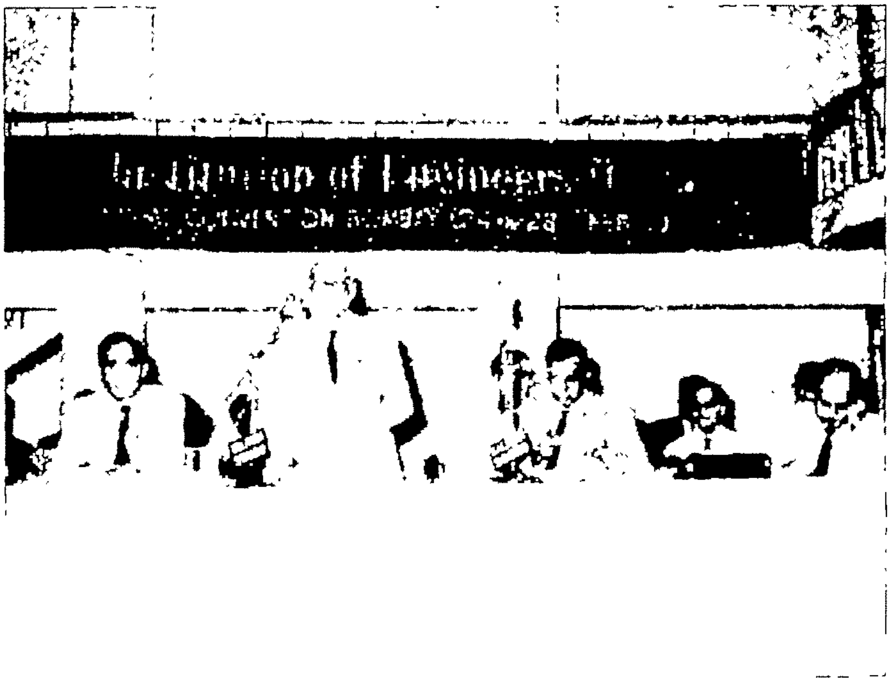


Sitting : (L. to R.) J. G. Bodhe, Major R. P. E. Vazifdar, K. F. Antia, Maj.-Gen. Harkirat Singh, Lt.-Gen. Sir Harold Williams, S. B. Joshi, S. R. Patkar, (*Mayor of Bombay*), B. P. Kapadia, S. K. Patil (*Minister for Railways, Chief Guest*), Maj.-Gen. S. P. Vohra (*President*), N. V. Modak, E. A. Nadirshah, D. P. R. Cassad, Prof. N. S. Govinda Rao, V. Y. Kamat, K. K. Nambiar, Prof. C. H. Khadilkar.

Standing : Front Row (L. to R.) M. R. Sitaram, Prof. H. C. Guha, P. J. Madan, Brig. M. A. Nayadu, V. D. Gupta, R. S. Metha, T. P. Manik, I. M. Magdum, Prof. M. V. Deshpande, M. Ganapati, K. C. Das, Lt.-Col. R. S. Attra, Prof. S. Panchanathan, S. P. Sinha, Dr. V. M. Dokras, H. K. Gandotra, S. K. Laha, J. P. Mital, Yadava Mohan, B. K. Dutta, R. N. Joshi

Standing : Back Row (L. to R.) R. N. Banerjee (*Secretary*), Prof. S. Rajaraman, Prof. P. C. Eapen, Kulbir Singh, D. G. Tamaskar, S. Padhi, D. R. Limaye, B. V. Raman, K. N. Rohatgi, Dr. A. Bhattacharyya

47TH ANNUAL GENERAL MEETING BOMBAY, FEBRUARY 1967



Shri B P Kapadia Speaking at the Business Session

Major General S. P. Vohra Delivering the Presidential Address

PRIZES BEING DISTRIBUTED BY SHRI S K. PATIL

SHRI PATIL AND MAJOR GENERAL VOHRA LEAVING THE CONVENTION HALL

47TH ANNUAL GENERAL MEETING BOMBAY, FEBRUARY 1967

A VIEW OF THE AUDIENCE DURING INAUGURAL SESSION

MAJOR GENERAL VOHRA TALKING WITH PAST PRESIDENTS

47TH ANNUAL GENERAL MEETING, BOMBAY, FEBRUARY 1967

Major General Vohra Addressing the Students' Session

Student Session in Progress

Maj.-Gen. S. P. VOHRA

PRESIDENT 1967-68

PRESIDENTIAL ADDRESS

The Honourable Shri S. K. Patil, Ladies and Gentlemen,

First of all, I would like to thank the Honourable Minister for Railways, Shri S. K. Patil, for agreeing to be the Chief Guest at the inauguration of this 47th Annual Convention of the Institution of Engineers.

Shri Patil heads the Indian Railways which is one of the largest public transport undertakings in the World and, in so doing, has the responsibility for improving among other things, the many-faceted and complex engineering activities of the Railways. He is thus closely associated with and appreciates the responsibilities and problems of the many engineering disciplines in the Railways—civil, mechanical, electrical and telecommunications. Under his able stewardship, the Railways have been able to achieve much to their credit in the engineering field such as laying of high speed tracks, dieselisation and electrification of high density sections, modernisation of signalling equipment, better telecommunication facilities and so on besides the all-important improvement in passenger amenities.

Shri Patil's ready acceptance of our invitation to be with us today, amongst engineers, is an indication that he fully appreciates the role, activities and worth of engineers and, particularly, that of the parent body—the Institution of Engineers—in the economic and industrial development of our country. We are indeed grateful to you, Sir, for your close interest in our affairs and for your acknowledgment of the importance and the vital role which the Institution of Engineers has to play, particularly now when our country stands somewhat apprehensive at the cross-roads of its industrial and economic development.

Again, it is a happy coincidence, ladies and gentlemen, that Shri Patil should be with us when the Convention is meeting at Bombay, for Bombay and Shri Patil are, if I may say so, inseparable sweethearts. The city of Bombay, which is probably our best administered city, owes so much to Shri Patil, its Mayor for over a decade, for its pleasing looks, cosmopolitan atmosphere and phenomenal growth. I would like to pay my tribute to the ability and foresight of engineers and administrators who have been and are responsible for planning and maintenance of this great metropolitan city. We are fortunate that many of these engineers are with us today in this Convention.

And now, about this Convention itself, I am immensely proud and conscious of the honour conferred upon me by my brother engineers in electing me to the Presidentship of the Institution of Engineers (India). It is a great distinction indeed, particularly for the military engineers of whom I am one. It is a measure of the regard in which our civilian engineers hold the engineers in the Defence Services. It is a rare privilege and at the same time a great responsibility to be asked to head the Institution at a critical time in our country's economic and industrial health. I am accepting this responsibility with pride and readiness, secure in the knowledge that I shall have the unstinted cooperation and active support of you all, not only to maintain and enhance the fine traditions of this great Institution, but also to bring about further improvements in its organization and technical activities.

It is the custom in our Institution Conventions for the incoming President to talk about his work, responsibilities and problems in the engineering discipline practised by him. It is a healthy convention. It enables others to share his experiences, to learn about the problems encountered in his sphere and how these are being resolved. I shall therefore try and explain to you the responsibilities and problems of the Corps I head, the Corps of Electrical and Mechanical Engineers of the Indian Army—the EME. My reference to this Corps in the Indian Army is also a measure of the importance which Defence has acquired in the recent years due to growing threat of external aggression on our frontiers by two of our neighbours. The strength and prestige of any sovereign nation ultimately depends on as to how well it can defend itself. To produce an efficient and strong military force we must have proper equipment in addition to adequate size of the forces for the purpose. A sound scientific and technological base in the country sustained by scientists, engineers and technologists is necessary to develop and produce the required equipment for the Army. This base must come, in the main from outside the active ranks of the Army—the civilian scientists, engineers and technologists engaged in research, development and production of equipment both in the public and private sectors. Equipment once produced has to be carefully maintained, repaired and kept fit for operational use and this task is performed by the Corps of EME. The task requires efficient and highly trained engineers as I would explain later. The point I wish to emphasize here is that there is an imperative need for close cooperation and understanding between the Corps of EME and all other engineers, scientists and technologists responsible for production of various equipment for the Army. Most of you present here, therefore, are directly or indirectly concerned with the Corps and my reference to the work and problems of the Corps will help in creating better understanding between us.

In the Army, military engineers are grouped under two technical corps—the Corps of Engineers and the Corps of EME. These are two different organisations altogether with quite different tasks. The Corps of Engineers' job is to help the Army to live, to move and to fight. They house the Army in peace and war through the Military Engineering Services (MES) which is a part of them. They help the army to move by constructing roads, bridges, air-fields and by overcoming obstacles in its path. They help the Army to fight by constructing field fortifications, minefields and the like.

The Corps of EME also helps the Army to move and to fight, but in a different way by looking after its transport and the entire arsenal of fighting equipment. You may say that the job of the EME is to serve the weapon that serves the soldier—'ayudhseva'.

Broadly speaking, the role of EME is to promote and maintain high equipment availability for operations and training with minimum cost in manpower and resources. Equipment referred to during the course of my lecture includes all technical equipment belonging to the electronics, electrical and mechanical disciplines. It includes highly sophisticated radar sets, guided missiles, transmission and receiving sets, armoured fighting vehicles, load carrying transport, earthmoving and road building equipment, small arms like rifles, giant long range guns and host of other technical equipment which goes to make a modern Army.

The task of EME starts either from procurement stage if an equipment already in production is purchased, or from development stage if a new equipment is under development. During the development stage, the Corps has to feed the designers information and advise in preferred methods of maintenance and repair in the field, the results of operational experience, etc. In turn it has to extract from the designers the training implications of new techniques, information for training and workshop manuals, test equipment and special tools requirements. Once the equipment is in service, the Corps has two main functions. Firstly, it has to ensure high availability and to return damaged equipment to battle worthiness in minimum time. This requirement necessitates field repair workshops near to the point of failure for repairs and base workshops for overhaul and heavy repairs in rear base areas. Secondly, the Corps has to ensure that the incidence of failure of technical equipment is kept to the minimum in operational use. This is taken care of by frequent inspection of equipments for serviceability and analysing common defects and carrying out remedial action. I will deal with various facets of these activities later but at present I like to emphasize the complex problems which all these duties involve. There has to be a proper organization to deal with these problems. To man such an organization by suitably trained officers and men requires a colossal effort. To add to all these problems the fast changing development in technology resulting in new equipments for the armed forces requires constant training of technical personnel. I will endeavour to tell you during the next few minutes briefly as to how we have met some of these problems.

Now, before I go any further I would like to briefly delve into the past and tell you the development of the Corps in its present form.

With little or no equipment present there should not be any need of EME and so the evolution of the Corps is really the story of the mechanization and 'equipmentisation' of the Indian Army over the years. Ever since warriors learned to wield the spear and the sword or fight from a chariot, the need for men to mend or sharpen these weapons arose. But evidently these men were not organised to function close to the battlefield, otherwise why should the redoubtable Karna falter, on finding his *rath* breaking down, and go down before Arjuna? An EME chariot-mechanic, had there been one readily available, could have easily saved the situation for him!

With the development of gunpowder and the appearance of the musket and the cannon, the need for a separate organization specialising in the repair of these weapons was increasingly felt. However, its emergence took quite some time, not until the formation of the Ordnance Corps about a hundred and ninety years ago by the British.

First World War brought in the armoured fighting vehicles—more commonly known as the tank in a crude form, the machine gun and the flying machine. Line telephony and the fullerphone, the spark transmitter, the crystal detector, etc., were extensively used for communications, but radio was little used and was mainly confined to the rear areas. Mechanical transport made its appearance in large numbers and some heavy pieces of artillery, *e.g.*, Big Bertha, were also developed. The fate of the house as an instrument of manoeuvre was definitely sealed in the West. But in India even after the First World War the bulk of the transport in the Army remained very 'unmechanical' indeed, based on the camel, the horse and the mule with the odd very unmilitary looking trucks thrown in here and there. Equipment was confined to mostly personal arms and some field guns. Technical maintenance remained in the hands of the user-arms and the supplying services.

In the United Kingdom, during the twenties and the early thirties, the development of the tank, which in 1918 was little better than a cumbersome steel box mounted on tracks, became bogged down in peace time lethargy and British conservatism. The Germans, however, were quick to capitalise on the British invention and forged steadily ahead with its development technically and tactically. However, during the late thirties, the British began to catch up and brought out some improved versions of the tank, *i.e.*, the Matilda and the Valentine. A new quick firing gun and improved versions of the old breach loading field gun began to make appearance as also the heavy complex mechanical fire control computers and power gun laying equipment for coastal artillery. Some more developments in air defence equipment and particularly Radar were well under way which were to have decisive impact on the course of the Second World War. Very little of all these equipment, however, reached the Army in India before the Second World War, except for the induction of a few tanks and armoured cars and some mechanical transport. Plans to modernize and mechanize the Indian Army were drawn up in late thirties and as a first step towards rationalization, the technical maintenance services of the army were reorganized in April 1939 into one organization—the Workshop Branch of the Ordnance Corps.

The outbreak of the Second World War and the early Allied reverses in North Africa coupled with the entry of the U.S.A. into the War triggered off a second equipment revolution in the Allied armies with tremendous spurts in development of new equipment. New tanks such as the Churchill, the American Lee, Grant and the Sherman, the 25 pounder quick firing field gun and the medium 5.5 in. medium gun-howitzer, whole family of new infantry, anti-tank and air defence weapons, improved telecommunication equipment for medium and long range operation, specialist assault and amphibious equipment—all these took the field and considerable quantities of these equimpent started arriving in India for the projected reconquest of Burma. India witnessed an unprecedented spectacle of equipment invasion in 1941-43 exceeding in scale, range and sophistication anything ever seen or visualized before. To enable the Army in India to absorb all this complex fighting equipment and to ensure its operational fitness and technical worthiness at all times, the need for a new centralized engineering organization was found imperative and the Corps of EME was formed on May 1, 1943. Such an organization had been formed in the U.K. a few months earlier.

During the Second World War, the EME played a very effective part in the recovery and repair of fighting equipment wherever Indian troops fought.

They shared with their comrades-in-arms, the honours gained by the Indian formations in North Africa, Italy, Burma, Malaya and the East Indies. Besides its normal commitments the EME also took on and successfully executed many ad hoc technical commitments including manufacture of small equipment and stores for the United States Navy, Army and the Air Force, the Royal Navy and the Royal Indian Navy and so forth.

After the Second World War, there was a run down of the armed forces in India, but very soon after the attainment of Independence, the Indian Army was back again on active service, this time as an instrument of national security, acting in Kashmir and Hyderabad. It was the EME's ability among other things, of course, to keep the war-worn equipment of the Second World War vintage in fighting trim that helped the Indian Army in those fateful days of 1947 to evict the Pakistani forces and raiders from Kashmir. I can recall to mind one or two episodes wherein the EME with characteristic resourcefulness and technical ingenuity was able to disassemble and despatch by air badly needed field and medium guns in the Poonch and Baramula Sectors in late 1947. Within minutes of the arrival of the Dakotas at the other end, EME went into action to reassemble the guns, under enemy shell fire, and got them ready to smash up the raider concentrations, then besieging Poonch and Baramula. Yet another episode is the literally breath-taking operation against the Pakistani raiders over the 11,000 ft. Zojilla Pass in 1948, to open up the road to Leh. Tanks were stripped of their armaments and turrets to get them post haste across the frail bridges on the road from Jammu to Baltal at the foot of Zojilla. At Baltal, an EME workshop re-assembled the turrets and armament in the tanks and also carried out certain major repairs. All this enabled the tanks to be deployed in a spectacular armoured action against the Pakistanis. More recently, in the 1962 conflict with China, light tanks were flown in a hurry to Leh and Chusul with the aid of modifications carried out against time by the EME. During the September 1965 conflict with Pakistan, the EME enabled our armoured formations to have maximum availability of Centurion and Sherman tanks for their daily epic tank battles against the superior Pakistani Pattons. EME's battlefield recovery of damaged tanks after sundown and their subsequent almost overnight restoration to battle-worthiness for the morrow's battle proved an important contributory factor for success in the Khem Karan and Phillora operations. Say the concerned infantry and armoured commanders *sotto voce*: 'Our artillery support and the EME backing have enabled us to win the war'.

Again, the EME's prompt technical attention of the fire control radar of air defence units guarding our forward airfields largely contributed to the security of these vital air bases.

Today, without needlessly indulging in statistical descriptions, I can tell you that the EME is perhaps the largest single monolithic complex of engineers and technicians in India. And I am sure our Honourable Minister for Railways here will not mind my saying that it is much larger than anything that the engineering branch of the Indian Railways can ever hope to match !

Having given you an idea of the growth of the Corps over the years, I must now turn to its organization.

I have already mentioned to you that the role of the EME is to promote and maintain high equipment availability to the Army. How this is achieved can be dealt with under three broad headings—firstly, the nature of the equipment, its range, complexity, and usage; secondly, the structure of organization for their inspection, repair and recovery, and, lastly recruitment, training and proficiency of personnel staffing this organisation

The Indian Army today despite its very modest make up *vis-a-vis* the armies of more developed nations like the U.S.A., the U.K. or the U.S.S.R. uses a vast range and variety of fighting equipment which may broadly be grouped under four main heads or disciplines.

Firstly, mechanical—mainly automotive equipment which consists of cars, load carrying vehicles, armoured fighting vehicles, earthmoving and road building machinery, air conditioners, machine tools, etc.

Secondly, armaments which include small arms like rifles and machine guns, artillery both light and heavy, anti-tank and anti-aircraft weapons in addition to a host of other equipment like mortars, etc.

Thirdly, fire control and optical instruments like binoculars, telescopes, range finders, dial sights, compasses, theodolites, infra-red equipment, etc.

Fourthly, electronics equipment including communication equipment like telephones, teleprinters, all types of wireless transmitters and receivers, radar sets for early warning, fire control and surveillance purposes, electro-medical equipment and last but not least the guided missiles.

All this is a formidable array of equipment embracing a number of engineering disciplines and techniques. The problems of looking after all this equipment becomes still more difficult as a large quantity of equipment now in service are from different countries following different national standards resulting in formidable difficulties in provision of spares, tools and test equipment. Some of the equipment is of old vintage and already out of production in the country of origin. To maintain such equipment it becomes necessary to manufacture a vast variety of spares in own workshops—sometimes even at comparatively high cost.

I may also mention here some other problems which add to the magnitude of our task. First is the wide dispersal of the equipment all over our country varying in climate and environments having entirely different effects on behaviour of engines and machinery. Consider Ladakh and adjoining areas situated nearly 18,000 ft. high with minimum temperatures of minus 35°F. in winter to arid desert areas of Rajasthan with 120°F. temperature in summer of Assam with very high humidity and temperate climate. In Ladakh touching of steel with bare hands would result in frost bite while in Rajasthan burns! Incidentally we had to develop gloves for use of technicians in cold weather in Ladakh to avoid frost bites while repairing equipment. Consider again the effect of lack of oxygen on internal combustion engines in Ladakh not to say of behaviour of lubricants, etc.

Second aspect which I would like to mention is that equipment in the Army at any place at any one time is mixed. For example an artillery regiment in the army will have mechanical transport to move guns and small arms to fire, optical instruments to direct fire and telecommunication equipment for communication between different sub units. This mixture of equipment, as you would appreciate, raises enormous problems for their maintenance and repair—not to talk of supply of spares in adequate quantities.

The third problem which I would like to emphasize is that the equipment is generally used in areas far away from the base where either equipment or its spares or other facilities for overhaul are normally available. It is often not possible either to get a replacement in time or to back-load the equipment to base for major repairs or overhauls. I will revert to this point while discussing the repair organization in the Corps a little later.

Now the tasks and how we meet them. I will first deal with advice to the research, development, procuring and user departments and arms. As mentioned earlier, we keep in close touch with the research and development organization. During development of an equipment we feed them with information and advice in preferred methods of maintenance and repair in the field, the result of operational experience etc. and in turn we extract from them the training implications of new techniques, information for technical and training manuals, test equipment and special tools requirement. We also associate with them for user trials to gather information on defect proneness of the equipment in order to have proper assessment of spares required for maintenance and overhaul during the first 2-3 years of the usage of the equipment Incidentally forecast of spares required for maintenance and overhaul is a complicated and important function Excess provision of spares locks up valuable money while inadequate provision may result in an equipment being out of service when it is urgently required in the battlefield. Consumption of spares on the other hand depends not only on design features and quality of material used but also on the extent of usage, climate and the terrain in which an equipment is used. Preparation of scales of spares required is a vast subject and I do not intend to go deep into it here. We have an organization known as the Technical Group EME which in addition to preparing scales of spares deals with other technical matters like investigation of common defects, preparation of modification instructions found necessary after introduction of an equipment into service, preparing technical and workshop manuals, inspection standards etc. of all equipment accepted in service. This organisation also collects feed back of technical and statistical data from the field on equipment performance which enables us after due processing and analysis to derive decision aiding information concerning preventive replacements, periodicity of checks and overhauls, areas of design improvement, areas of special training or repair attention etc. To advise user units on technical problems and coordinate working of all EME units in an area, we have EME staff officers in the Headquarters of all formations.

Our next task is inspection. Inspection in the Army is as important as in any industry. But unlike in industry, where inspections are concentrated in the factory, for army equipment a wider inspection network is needed which can deal with all natures of equipment whatever their status and location. For example, a periodic inspection of equipment in the hands of troops ensures that the equipment is used sensibly, user preventive maintenance is carried out regularly, necessary repairs are carried out in time and that there are no inherent design or manufacturing defects present or suspected. Inspection of equipment in reserve stored in depots, is also carried out to make sure that the equipment does not deteriorate in storage and that before issue to troops it is in 'fighting fit' condition. Then there is the inspection of the output from various EME. workshops to ensure that repair and overhaul is sound, complete and in accordance with standards. The inspection set-up in the base workshops bears a close resemblance to the quality control organization in a modern factory. Inspections of equipment used by troops in varying environmental conditions of terrain and climate and those carried out on equipment in storage do bring to light various weaknesses or defects in design, manufacture or material. These are rectified, after due investigation, in the form of modifications to equipment as mentioned earlier. Such instructions are also issued by the Technical Group mentioned earlier.

Now I come to our major role of repair and overhaul of equipment. Our aim in organising repairs is to return a damaged equipment to battle worthiness in the minimum time. This requires repairs to be carried out adjacent to the point of failure. If we could provide facilities for all types of repairs there, then the matter would have been simple but this is not possible. I would like to make two points here before I go further. First, the war of today is not fought in static lines and decision, of victory and defeat are not arrived at in a single battle as in old days. Mobility is the essence of army's ability to fight and troops and equipment may have to move hundreds and thousands of miles in a long drawn war. Secondly, warlike equipment like tanks, vehicles, guns, wireless sets are found right with the front troops and points of failure of equipment may be right under the enemy fire. I have mentioned these points to emphasize that mobility and time must be given high degree of consideration in evolving any system or organisation for repairs.

We have, therefore, conflicting requirements of repair organization from technical and military points of view. From technical point of view we would like to have large static installations with suitable accommodation where work could be carried on in planned and steady flow system with specialist machinery. Military considerations require a mobile flexible organization capable of working in the open in improvised shelters with limited facilities. The organization should also be capable of quick deployment splitting into small groups, if necessary, to carry out repairs as near to the point of failure as possible to reduce time an equipment is out of service.

In evolving an organization for repairs proper balance has to be kept between the requirements of engineering efficiency with military requirements. This is achieved in the Corps by having four echelons of repair. First echelon is called light repairs, the second and third field repairs and the fourth base repairs.

Light repair units are generally called 'Light Aid Detachments' (LAD). This is the first tier of EME support. Each major mechanized unit of the fighting arms such as armour, artillery and signals, has attached to it an EME

Light Aid Detachment, which varies in strength upto a maximum of 1 officer and some 90 technicians. These LADs are mobile and keep peace with their parent units. They have hand tools, special maintenance tools and in larger detachments welding and battery charging facilities and mobile (vehicle borne) workshop facilities. Their role is to undertake quick repair which can be effected without loss of mobility and their organisation is based largely on military considerations. They can change sub-assemblies and do small manufacturing jobs and on occasion they may even change major assemblies such as engines and transmission units of vehicles and tanks. Light and quick repairs to armaments and electronic equipment are also undertaken.

Field repair workshops represent the second and third tier of EME support and are known as second and third line workshops. The workshops are equipped with powered machinery which includes a fair sprinkling of specialised machinery, a wide range of tools, gauges and test equipment as well as hoisting and handling equipment and portable workshop shelters. Second line workshops are mobile and can be sited fairly close to concentrations of fighting equipment in the hands of troops that they support. The strength ranges from 6 to 7 officers and 250 to 400 combatant technicians in each workshop company. A brigade group or equivalent is assigned such a workshop which can handle a wide range of equipment. Specialist vehicle-borne workshop and repair equipment are provided for repairing tanks, MT, weapons, guns, instruments and electronic equipment including radar. The workshops can provide mobile repair teams to go well forward to deal with damaged tanks and other important heavy equipment such as guns and tractors, which cannot be easily brought back to the main workshop site without undue effort or loss of time. The moral scope of these workshops comprises repairs to major assemblies and systems, replacement of major assemblies, recoil systems of guns, alignment, specification testing and calibration of electronic equipment and so on. Manufacture of spares and parts is also undertaken. All this type of work calls for a measure of stability and the second line field repair workshops are afforded every chance compatible with the military situation to stay put for reasonably long periods. The third line workshops are much bigger than the second line workshops and they are semi-mobile with a greater range of specialised machinery like cylinder honing and crankshaft grinding equipment, and other machine tools for the overhaul of selected major assemblies. These workshops are in support of second line workshops of the divisions and in fluid military situations accept the overflow of work from the latter to keep them mobile and free for operating with their parent formations.

Lastly, there are base repair workshops which are also known as 4th line workshops. In these workshops heavy repairs including complete strip and rebuild of equipment or selected overhaul are undertaken under static conditions similar to a factory or a large reconditioning railway or transport workshop. Here engineering, rather than military considerations, dominate except perhaps for certain repair priorities imposed by the General Staff as dictated by the overall operational requirements. These workshops are provided with suitably designed technical accommodation and other facilities, a wide range of general purpose and specialist machinery, overhead cranage and material handling equipment and skilled civilian labour with scope for carrying out full scale manufacture of not only spare parts and components incidental to repair but also certain complete stores such as trailers and vehicles bodies. A modern and well equipped tool room for the manufacture of special tools, jigs and fixtures is also provided, besides a well equipped laboratory with chemical and metallurgical testing facilities. There is full scope in these workshops for application of modern engineering methods and management techniques. Although these workshops function as full blown industrial units, it must be appreciated that these are very much complementary to the rest of the repair organisation and serve as a vital link of the integrated repair chain in the field. There is also a modified type of the Base Workshop known as Advance Base Workshop which carries out similar role in forward areas, with a view to trapping as many unserviceable equipment and assemblies needing overhaul as far forward as possible to ease the logistical burden of rearward evacuation.

As an adjunct to repair the EME has a recovery organisation equipped with wide range of recovery vehicles—wreckers, including armoured recovery vehicles, tractors and trailors to extricate, recover and evacuate tanks, vehicles, guns and other heavy equipment that have become damaged, ditched or bogged. The job of recovery organisation is to search and recover from the battlefield and other areas all equipment casualties to the nearest EME workshops or specified equipment collecting posts for further backloading rearwards for eventual repairs and overhaul in rear areas. The ability and boldness of the EME in recovering tank casualties, even while a battle is going on, to workshops for speedy repairs and restoration to operational fitness, is generally a major battle winning factor in tank battles.

Having dealt with the organization of the Corps, I now come to personnel. Our personnel both officers and men have to be good in both professional and military duties as they have to work in forward areas and are required to defend themselves in battle. The training of nearly 3,000 technical officers and many thousands of technicians is a task of great magnitude for which we have two very well equipped schools and three training centres.

Let me take the training of technicians first. A technician must be a resourceful and versatile craftsman, fully trained in one of the 24 basic engineering trades of the Corps. He must have an adventurous outlook and be absolutely fit mentally and physically to be able to respond to the challenge of the raw and the wild and the little known. Besides being a technician, he must also be a soldier trained to play his part as a disciplined combatant Frankly, I have to admit that although there is no dearth of the type of men that I have described in our country, the Corps is somewhat disappointed to see that there is not by any means a rush of such persons to volunteer into the Corps of EME. By this I do not mean that the response to recruitment is not good; in fact, all our annual recruitment programmes are oversubscribed. But we are not finding it easy to get the right man with technical aptitude and scientific attitude of mind. I suppose we are all competing for scarce material all round and the fact that the army cannot match the monetary awards open to such personnel in other walks of life is probably the cause. But then we have more to offer in the way of comradeship, *esprit* *de corps* and variety which in the ultimate analysis count for more than mere monetary rewards.

Our men come from all over India and the Corps is of multiclass composition. At present we have only the adult entry and young men come to us from towns and villages with educational qualifications ranging from middle school to high school and even P.U.C. They are given military training and then depending on the results of certain psychological trade aptitude tests administered to them, trained in one of the 24 basic trades of the Corps *e.g.* gun fitter, vehicle mechanic, electrician, radar mechanic and so on. The man is then sent to an EME workshop in the field for on-the-job training after which he takes his legitimate place in the organization. From time to time, as he matures, he attends trade upgrading courses and tests for advancement up the trade proficiency ladder. Every year a general competitive examination is held to select suitable young tradesmen for advance technical training normally upto Diploma standard; and development of supervising qualities, to become what we term armament artificers in the Corps. These men ultimately rise to JCO rank and some of them secure Special List Commission in the Corps.

To improve the quality of supervisory personnel as also to generally stiffffen up the technical rank and file of the Corps, we are presently working on a scheme of apprentice entry. The idea is to select young and promising high school or even higher secondary school boys, age group 15 to 17, and give them intense scientific, military and technical training for three years in a specially staffed and well equipped apprentice school. These boys will emerge as full fledged tradesmen and then be potential armament artificers.

As regards officers, who form the professional grades of the Corps, the job requirement is for a chartered engineer of either the mechanical, electrical or the electronics discipline. I would like to remind you that the EME officer during his career may be called upon to command or work in an EME workshop ranging from Light Aid Detachment of one or two officers and 90 men through a field repair workshop with 7 officers and 250 to 400 men to an army base workshop with about 30 officers and about 2,500 combatant and civilian personnel. He may have to work as a technical adviser and consultant on equipment matters to the commanders and troops in a formation. Or he may, while in the Technical Group, be associated with the design and development of new equipment or writing of technical literature or research in new repair techniques or in preparation of spare parts scales and so on.

The young EME officer has therefore to have a sound Corps oriented engineering training covering practically all disciplines that are associated with fighting equipment so that while commanding a small workshop by himself he is able to cope with a variety of problems. As he matures, he may have to do an advance engineering course which is equipment oriented but with a strong underpinning of conceptual and theoretical knowledge concerning design. As he further matures, he is trained in general and production management which includes work study, materials management, production planning and control, wages administration and factory legislation to be able to serve effectively in the Corps base workshops and the Technical

Group. The technically bright and promising officers of the Corps are sent on post-graduate courses to Universities in India and abroad so as to further educate and equip them for design and developmental work in the Corps and outside. Every officer of the Corps, whether he is mechanical or electrical, is taught electronics to be able to exist in the somewhat over-powering and ever thickening atmosphere of electronics in a modern army. Besides, a high percentage of the officers are trained for specialisation in advanced electronics to be able to cope with the ever increasing volume of sophisticated electronic equipment in the army.

The officer entry is *via* two streams. The NDA-IMA cadet with aptitude for science and mathematics is commissioned into the Corps and he undergoes the Corps oriented three-year army degree engineering course jointly conducted at the College of Military Engineering, Poona, and EME School at Secunderabad. The other stream brings in the University product, a bachelor of engineering in mechanical, electrical or electronic disciplines. They are both treated on par for further training and employment. We have also a scheme under which some of our best NDA-IMA trained officers are sent to Universities for an engineering degree.

You would pardon my indulgence if I say that an officer trained in the EME has very high professional and managerial competence and this is proved by the fact that a large number of our serving and retired officers hold responsible positions in both private and public sector undertakings.

I have so far given you an account of the responsibilities, organization and problems of my Corps. Officers of the Corps of EME by virtue of their training and association with a broad spectrum of engineering activities in relation to the design, development and repair of equipment, are also eminently suited to play an important part in the logistic or equipment management of the army. Presently their employment is largely restricted to the execution of their engineering function although senior staff appointments in the logistical, equipment and administrative departments in higher Headquarters could be given in increasing proportion to suitably qualified EME officers. An occasional representation is there, no doubt, but there are no signs of any definite spread in this direction. Perhaps the reason is the psychological aversion to change prevalent all over.

I find that a somewhat similar situation, but on a distressingly large scale, exists in technical departments of the Government and public sector enterprises. Unfortunately we persist in continuing the system which the British adopted to administer a dependent colony. The aim of the British was to keep India as a supplier of raw material and market for consumption of their industrial products. The then Government of India while giving patronage to British commercial interests did not itself participate in industrial activities in the country and considered keeping law and order and collection of revenue as its prime function. To carry out these functions, the Government instituted a secretariat system of administration with power and authority concentrated at the top with the elite 'generalist'—Indian Civil Service Officers. The one exception to this system was the Indian Railways, inherited as a package deal from the erstwhile British owned railway companies with enlightened system of management similar to any commercial undertaking. Even in those days the British recognized the advisability of running the railways through Railway Board manned by railwaymen, without imposing intermediate secretariat system, for efficient functioning. One would have thought that with increasing participation of the Government in major industrial undertakings, it would at least administer these not only on the lines of the Railway Board but improve it by instituting a system based on modern management techniques. However, to the dismay of all professional men, the Government is merely transferring its civil servants and introducing outmoded secretariat and financial systems to run the public sector undertakings and technical departments. A return of 1½-2% per annum only from these undertakings in which we have invested nearly Rs. 2,400 crores is an indication of their poor performance under the present system of management.

Modern administrative machinery necessary to develop a welfare state on socialistic pattern of society is a complex undertaking. The deep involvement of the Government in the process of production calls for knowledge, skill, judgment, aptitudes and experience not normally found in traditional civil servants. An analysis of the inefficiencies, delays, increase in expenditure and such other drawbacks in the final results, will indicate that in a large number of cases these shortcomings, are due to diffusion of responsibility resulting from the intermediary of the secretariat and financial system. I consider that the bureaucratic system with its complicated ritualistic code and procedures as prescribed by the civil servants must be changed to enlightened business and management practices followed by professional men in successful commercial undertakings.

In order to elevate the living standards of under-developed countries, it is necessary to raise national income by increase in agriculture and industrial production. This entails firstly proper scientific and technical education, research and development of new methods, techniques and products. Secondly, optimum use of natural and material resources of the country to increase production in various fields. The scientist, the engineer and the technologist is more suited to make significant contribution as compared to the general purpose administrator towards this end. Our present administrative system does not ensure that the scientist, the engineer and the technologist are given positions where they can effectively contribute to the industrial and economic development of the country. It would be appropriate to mention here that in technologically advanced countries like the U.S.S.R., the U.S.A., the U.K. and France, many of the technical departments and planning bodies are headed by engineers and experts and not by generalist administrators. We must, therefore, follow similar pattern in this regard in this country if we are really keen to hasten our progress.

I hope that the Administrative Reforms Commission headed by Shri Morarji Desai would look into this aspect of administration of technical departments and public sector undertakings. The Institution of Engineers (India) has submitted a memorandum to that Commission recommending among other things that the technical personnel be given responsible administrative positions including members of Cabinet at Centre and State Governments dealing with technical and industrial departments. The present system of administration and financial controls should also be reviewed keeping in view the current needs of the country. I am sure that the Administrative Reforms Commission would take note of our recommendations and suggest appropriate action by the Government as I am of the firm opinion that unless scientists, engineers and technologists are given responsibility and with it necessary authority to run these undertakings on commercial basis, there would be no appreciable improvement in our economy. Finally, I have no hesitation in saying that so far as technical departments are concerned, the days of generalist administrators are over and the technocrats have to take over technical departments as early as possible—the earlier the better if a major set back in our economy is to be averted.

I do hope that I have been able to arise your interest in the working and problems of the great Corps of Electrical and Mechanical Engineers and have also succeeded in focussing your attention on burning problem of administration of public sector undertakings and engineering departments. Notwithstanding the recommendations of the Administrative Reforms Commission, much will depend on the way we ourselves perform as engineers and administrators. Our administrative and technical integrity, competence and dedication to developing an industrially prosperous society will be keenly watched by the people and their final verdict will be influenced not by our talk and promises but by actual deeds and results. I have no doubt that we will rise to the occasion.

I now request our Honourable Minister to address the gathering.

JAI HIND

Summaries of Papers Published in the Journal, vol. 47, no. 6, pts. EL 3, CH 2 and PH 2, February 1967

ELECTRICAL ENGINEERING DIVISION

621 317.4 . 621.375.13

1. A Current Feedback Method for Correction of Flux Wave Distortion in Incremental Magnetic Testing. Prof. J. K. Choudhury, *Associate Member,* **R. K. Mondal,** *Non-member,* **and Dr. S. N. Bhattacharyya,** *Non-member.*

Recently voltage and current feedback techniques have been successfully used for curing the flux wave distortion in magnetic test samples. Of these two methods, the voltage feedback technique is comparatively more inconvenient since it involves the use of a very high gain amplifier requiring elaborate precautions for preventing self-oscillations and instability. In this paper a new current feedback method especially suitable for the elimination of flux wave distortion and asymmetry during incremental magnetic testing is described. In this method, a loop gain of about 2 only is sufficient for the feedback circuit. Selected experimental results on a Stalloy and a Mumetal sample have been included in the paper to illustrate the effectiveness of the authors' method.

621.318.2.001

2. Transient Characteristic of Cylindrical D. C. Magnets and Brakes—I. Dr. A. K. Das Gupta, *Member.*

In this paper the eddy current time constant for cylindrical D.C. magnets is deduced. The transient expression for flux density is also deduced. Improvement of design has been discussed and it is expected that the expressions for eddy current time constant will provide a better in-sight in the design of the magnets and brakes

621.3.04 . 621.819 4

3. Analysis of an Electric Circuit Containing a Nonlinear Capacitor. R. M. Garde, *Student.*

A circuit containing a nonlinear capacitor and a linear inductor without a resistance is analyzed. The circuit considered is subjected to a harmonic potential. The differential equation governing the circuit is approximated to a form in which the right hand side becomes zero and is then solved in terms of elliptic functions. The approximate method presented is much simpler than other methods used for analysis of such a circuit

621.3.012.6

4. State Model and a Closed Form Method of Solution of the Linear Case. Dr. V. K. Jain, *Associate Member.*

In this paper a procedure for analyzing dynamic systems is given based on its state model. For the linear case, certain formulae are developed which enable calculation of response in real numbers and are particularly suited to a digital computer. A computer flow-chart is given which uses the theory developed.

621.313.333

5. Effect of Magnetic Saturation on Transient Currents in Induction Motors. D. R. Kohli, *Non-member,* **and V. K. Maini,** *Non-member.*

Transient currents in induction motors consequent to switching in, reconnection to line, and plugging are considerably influenced by the state of magnetic saturation in the machine. In this paper, the results of a study on the effects of saturation on the induction motor transients are reported. Transient currents during different types of switching operations were recorded for a 5 h.p. squirrel cage induction motor. These currents were also computed by Lyon's approach using unsaturated values of motor parameters. Comparison of the test data and the computed values shows that during all the modes of switching operation, saturation, obtaining at the rate applied voltage of the machine, causes a reduction of about 15-20% in the peak instantaneous stator current expected with the same voltage in the absence of saturation.

621.315.001

6. Unbalances of Untransposed Transmission Lines—1: Electromagnetic Unbalance of Single-Circuit Lines. Dr. K. S. Raman, *Associate Member,* **and S. V. Subrahmanyam,** *Non-member.*

Recent developments in power and communication systems have reduced the need for frequent transposition of power transmission lines. Several modern transmission lines built in the U.S.A. and Canada are transposed only at substations or switch-yards; some lines have been built without transpositions. In this paper the electromagnetic unbalance of untransposed, single-circuit transmission lines is analyzed from fundamental principles. Lines without ground wires, with one ground wire and two ground wires are considered. Expressions are derived for the negative and zero sequence electromagnetic unbalance factors and the unbalance of a 220 kV single-circuit line of the Andhra Pradesh State Electricity Board is studied. General charts for finding the approximate unbalance factors are given.

621.315.5.001

7. Subconductor Tensions in Partially Broken Conductor Bundles. V. N. Rikh, *Associate Member.*

The subconductor over-tensions and longitudinal force on tangent towers, which result from a partial damage to the conductor bundle, form important aspects for mechanical design of bundle conductor lines. With the method developed in this paper, these forces can be determined in individual cases. It is found that for commonly used ACSR sizes, the subconductor over-tension factor is considerably affected by the ratio of tensions on the two sides of the suspension point, joining the damaged and healthy bundles, as also by the number of spans in the line section. The span length, however, has comparatively less effect on the over-tension factor. The longitudinal force on the tangent towers due to a partially damaged conductor bundle is found to be fairly small.

621.313.333.

8. Allowable Output from a 3-Phase Induction Motor Connected to Unsymmetrical Supply. Dr.-Ing. N. N. Roy, *Associate Member*.

Most of the motors used for industrial drives today are 3-phase induction motors. They are designed to operate satisfactorily with balanced supply. Experience indicates that there is no supply system which gives perfectly balanced voltages at the consumers' terminals. Therefore it becomes necessary to have an idea of the safe limit of the allowable load from a 3-phase induction motor when connected to unsymmetrical supply. The author proposes a method of computing the relative magnitude of the allowable load in terms of the rated load. A chart which can be used for any motor, the voltage unsymmetry being known is given. Of course certain quantities of the motor are to be ascertained experimentally which has been explained in detail. It has also been tried whether some other method may be used to avoid these quantities.

621.313.333.001

9. Analysis of Induction Motor—a Topological Method. L. B. K. Sastry, *Non-member*.

This paper presents a new technique of predicting the operating characteristics of a 3-phase induction motor by using the concepts of topological relationships. In the first instance, a topological model is developed for the induction motor. The analysis of the induction motor is obtained from the topological model. This procedure presents a simple approach to the analysis and permits the study of the machine by mere observation of the model. The calculated values are verified by load test on a 3-phase slip-ring induction motor and it is found that the results obtained are reasonably accurate.

621.314.001

10. Application of a Topological Method to the Analysis of Power Transformer. L. B. K. Sastry, *Non-member*.

This paper presents a new approach for the determination of the operating characteristics of a power transformer by a topological method. A topological model based upon the analytic function of the transformer is developed The analysis of the transformer is worked out from the model with the aid of the transmission formula. This method provides a general approach for the analysis of transformer and permits the study of the physical system by mere observation of the model. The calculated values are verified by load test on a single-phase transformer. It is found that a good agreement of the results is obtained.

621.313.3.00

11. Predetermination of Performance Characteristics of Schrage Motor. K. Venkatesan, *Non-member*, S. K. Jain, *Non-member*, and Dr. L. M. Roy, *Non-member*.

The performance equations of scharge motor are derived in terms of experimentally determinable constants of the machine. The impedance matrix is used to deduce an exact equivalent circuit to the schrage motor.

It has been shown that the behaviour of the schrage motor can be predicted accurately with the help of these equations in all the operating conditions. For a particular case of neutral set machines, the approximate equivalent circuit derived from performance equations gives a fair estimate of the operation. The tests to determine all the constants involved are given. The calculated values of torque, current, power factor and efficiency have been compared with test results.

CHEMICAL ENGINEERING DIVISION

678.620.17

1. A Critical Review of Recent Work Done on Mechanical Properties of Polymers. B. P. Gupta, *Non-member.*

This paper reviews the work done on various mechanical properties of polymers. The properties discussed here are motion study, internal friction, wave propagation, creep, fracture criteria, mechanical behaviour and visco-velocity.

664.7

2. Some Fundamentals of Chemical Milling. N. Appa Rao, *Non-member,* **and G. V. Ramanaiah,** *Non-member.*

Some fundamental aspects of chemical milling, its applications, commercial tolerances, advantages and disadvantages are dealt with in the paper.

PUBLIC HEALTH ENGINEERING DIVISION

628.1 : 551.49

1. Method of Tapping Sub-Surface Water with Particular Reference to Water Supply for Gujarat Refinery Project. U. J. Bhatt, *Member.*

An ordinary well sunk in the traditional manner can have contact with the underground table from which it draws its supply only along the periphery in contact with the water. The greater the surface of this draw-off, the greater are the chances of drawing a big supply into the well, provided the water never exceeds that allowed by the permeability co-efficient. If, therefore, a larger supply is required, it is necessary to increase the surface in contact with the underground water. This is done by constructing a 'puits developee'. This enlargement of development of the well is effected by means of radiating pipes called in French 'drains radiants'. A 'puits developee' with 'drains radiants' consists of a cylindrical well of reinforced concrete going into the alluvium to as great a depth as possible. From the bottom of the well, 'drains radiants' are driven horizontally, being made of steel pipes of 200 mm. diameter on the inside, and going upto 40 m. in length. The length is determined by the texture and yield of the alluvium. This French method of tapping sub-surface water is described in this paper in relation to water supply for Gujarat Refinery Project.

576.851.001

2. **Sulphur Bacteria. S. K. Gajendragadkar,** *Associate Member.*

The sulphur bacteria form on important group of micro-organisms both microbiologically and industrially. The different species that interest the sanitary engineer are discussed in detail. The importance of sulphur bacteria in the sulphur cycle in nature is also brought out.

621.643 : 621.316.1 : 681.14

3. **Digital Computer and Its Use in Pipe Network Analysis. S. Mitra,** *Non-member,* **and Prof. A. K. Deb,** *Associate Member.*

As the new developments are coming up in engineering design and research, computations involved are also becoming complicated and time consuming. Methods of computation for such problems are always undergoing improvement to reduce the overall cost and to improve the accuracy of results. Digital and analogue computers are generally used for such computations. In this paper authors developed a general programme for the solution of complicated pipe network analysis in high speed digital computer using a new method of balancing equivalent pipe length which should provide added economy in engineering design. The procedure of solving pipe network by digital computer has been illustrated by one example of complicated network.

628.336.001

4. **A Laboratory Study on the Effect of ABS on Anaerobic Sludge Degestion. S. K. Mitra,** *Associate Member.*

This paper describes a laboratory study of the effect of the synthetic detergent ABS (or, alkyl benzene sulfonate) on anaerobic sludge digestion leading to the determination of the concentration of the surfacant at which digestion fails.

711.4

5. **Requirements for Design and Desirable Standards for Human Habitation. V. Raman,** *Associate Member.*

The various factors contributing to a healthful housing are site, privacy, room size, ventilation, thermal environment, noise, sanitary facilities, etc., and their roles are brought out from the point of view of health and social needs of man. The recommended minimum standards of residential environment are enumerated along with a comparative statement from a few other countries.

721.00

6. **Appraisal Techniques for Measuring Objectively Hygienic Quality of Housing. V. Raman,** *Associate Member.*

Housing being a part of the total environment is to some extent responsible for the status of man's health and well-being. Considering these factors, basic principles of healthful housing are enunciated. Appraisal techniques used for measuring objectively the hygienic quality of housing are discussed and their importance stressed.

Summaries of Papers Published in the Journal, vol. 47, no. 7, pts. CI 4, ME 4 and MM 2, March 1967

CIVIL ENGINEERING DIVISION

624.15 : 550.34

1. Geophysical Investigations and Their Application at Foundry Forge Project Site, Ranchi (Bihar). V. J. Pandey, *Associate Member.*

This paper discusses the seismic and electrical resistivity methods employed for the geophysical exploration for the civil engineering works. The latest electronic developments and modern instruments of geophysical surveys have solved the foundation problems to a large extent.

691.32.001

2. Comparative Study of Field and Standard Cured Concrete Cubes. P. Dayaratnam, *Associate Member,* **P. D. Prasadarao,** *Non-member* **and M. A. R. Ansari,** *Non-member.*

A series of concrete cubes made out of the same mix but cured in the field and in the laboratory are tested and the comparative study of strengths of cubes for various water-cement ratios is made. The ratio of the strength of field-cured cube to that of the standard-cured cube is defined as field-factor and a set of field-factors are determined for various water-cement ratios. It is observed that the field-factor increases with increase of water-cement ratio. Strength of field-cured and standard-cured concrete cubes with respect to the density of concrete cubes is also pressnted in this paper.

624.131.53

3. Stability Analysis of Slopes by an Analytical Method. Dr. A. Siva Reddy, *Associate Member* **and R. J. Srinivasan,** *Non-member.*

The 'stability analysis of slopes' is one of the topics in which a computer is used for solving the problem analytically. In this paper, a new method for the stability analysis of slopes, which considers infinite number of slices is presented with use of Bishop's approach. Numerical results are obtained with the use of a digital computer and compared with the conventional method taking infinite number of slices and with the Bishop method taking finite number of slices. The value of the factor of safety given by the Bishop method taking finite number of slices converages to the value given by the analysis presented herein as the number of slices is increased. The present analysis also gives a higher factor of safety than the conventional method. Also, this takes less time for computation than the Bishop method. As such, it is recommended for adoption.

551.482

4. Stable Dimensions of Rivers in the Deccan Plateau. V. Singh, *Non-member.*

Robertsganj-Garhwa Road, Obra-Singrauli and Singrauli-Katni Railway lines run across the catchment area of Sone crossing practically all of its major tributories and River Sone itself at two points. Considerable data have been collected for these rivers for designing the bridges across them. Many of these rivers have scourable beds and banks and are free to adjust their slopes and cross sections to attain stability. In this paper, the data for these rivers have been co-related and the relationships which govern the variation of bed width, depth and bed slope with the discharge, have been established and compared with the equations given by Lacey and Blench.

627.8 : 628.1

5. Roll up and Fold Away Dams. T. B. Modak, *Non-member.*

A novel method of constructing small dams, viz., 'roll up and fold away dam' has been developed in U.S.A. claiming considerable economy and simplicity in construction. This paper discusses the salient points of the method and recommends it for impounding water for the domestic consumption or for irrigation in our country on small scale.

624.072.3.001

6. Frame Analysis. U. C. Pattanayak, *Associate Member.*

In this paper, formulae for analysis of frames are presented which can dispense with the long, laborious procedures of moment distribution, iteration or the successive approximation procedures which are looked upon as the last word by the engineers.

There are quite a few approximate, empirical formulae available such as the formulae published in the 'Reinforced Concrete Designers' Hand Book' by Reynolds, coefficients published in A.C.I. handbook for R.C.C., coefficients recommended in the B.S. Code C.P. 114 (1957) etc. but a rational and accurate formulae amenable for derivation remained a necessity for a long time.

691.32.001

7. Laboratory Study of Concrete Overlays. B. G. Sharma, *Non-member,* **N. K. Vaswani,** *Associate Member,* **and S. K. Khanna,** *Non-member.*

This investigation in overlays has been carried out to study the importance of bonding of overlay to base slab, and thereby evolve a laboratory testing procedure wherein the extent of reduction in thickness of such partially bonded overlays, with various bonding treatments at the interface, can be known. An effort has been made to lay down a modified equation, based on the Corps of Engineers' equation for partially bonded overlays which shall incorporate the effect of various bonding conditions under study.

624.074.4 : 624.072.2

8. Effect of Edge Beams on the Stresses in Cylindrical Shells. Dr. A. S. Arya, *Associate Member,* **and S. K. Agarwal,** *Non-member.*

The effect of size and shape of edge beams on the values of the stress resultants in cylindrical shells has been studied in short, intermediate as well as long shells by taking shells without edge beams, with narrow deep shape, square shape and narrow flat shape. Besides the above, the case of narrow deep edge beam joined to the shell edge at its mid depth has also been considered. For computation of results Holand's theory has been adopted. The calculations have been made by means of I.B.M. 1620 Digital Computer.

In order to study the range of applicability of Schorer's theory to cylindrical shells, all the computations indicated above have been repeated using Schorer's theory and results compared with those obtained by Holand's theory. The main conclusions arrived at are that in all cases narrow deep edge beams are superior and that when deep beams are used Schorer's theory could be applied for designing long and intermediate shell. In short shells, the error in singificant forces T_x and M is about 10 and 40% respectively.

624.155.001

9. Determination of Lateral Load Carrying Capacity of Pile Groups in Field.

S. L. Agarwal, *Non-member*, and **S. Prakash**, *Associate Member*.

Pile groups are generally employed to resist large lateral loads acting on bridge abutments, piers, retaining walls, machine foundations and water front and off-shore structures. The spacing and general layout of the piles is decided on the basis of judgement and experience. Maximum permissible displacement of pile group limit the allowable lateral load in many cases. Determination of load-displacement characteristics of pile groups for different spacings of piles in advance of construction is, therefore, of great importance in estimating the load the group could carry.

From design point of view, it is desirable that load carrying capacity and load-displacement of a group be correlated with similar characteristics of a single pile. Data on a single pile can economically be obtained from a field test. This investigation was undertaken with a view to determine the lateral load capacity of pile groups from design considerations and to study their behaviour theoretically.

The tests were performed on actual structural single piles and pile groups under the field conditions at two sites. The soil at one site was sand, whereas, that at the other, it was clay. The lateral load was applied by means of hydraulic jack inserted in a horizontal position between two single piles and two symmetrical groups of two, four and eight piles. The displacements were measured both at the ground and the load level for each increament of load.

In the analysis, soil modulus, constant with depth for clayey strata and linearly varying with depth for sandy strata, were assumed. From the load-displacement curves of single piles, similar characteristics of pile groups were predicted considering group effect and fixity of their heads. The predicted curves of the groups were compared with the observed curves of the respective group. Such a comparison is being reported here for the first time in available literature. The curves determined for groups for two major varieties of soils, i.e., sand and clay tally closely with the observed ones and, therefore, the method adopted in this paper should have universal application. Thus, from a single pile data, a field engineer can design the pile groups on a rational basis.

624.073

10. Circular Plates Carrying Linearly Varying Load.

Dr. A. S. Arya, *Associate Member*, and **A. S. Pathak**, *Non-member*.

The circular plates with or without a concentric hole are analyzed when subjected to lineraly varying load The usual small deflection theory of medium thick plates has been used. Closed form solutions have been derived for internal forces in terms of polar coordinates.

The plates have been analyzed with simply supported or free edges carrying distributed loading having zero intensity at centre and maximum at the edge, or knife-edge loading lying on a concentric circle, having zero value on one diameter and varying linearly with perpendicular distance from this diameter. Critical values of moments and shears in various cases are tabulated for direct use.

691.872: 620.193

11. Increased Corrosion Danger through High Tensile Reinforcement. Dr. S. Soretz, *Non-member.*

The use of high tensile high bond steel allowing higher permissible stresses results in more elogation of the tensioned steel and increased crack width. These involve incresed danger of corrosion of the steel. In this paper, the author has dealt with the cause of protection of steel by surrounding concrete, the comparative influence of crack formation in high tensile steel and ordinary mild steel, and the results of investigations on the behaviour of the structures already in service for a long time. It is concluded that the failures of steel in reinforced concrete members have occurred exclusively when the codes of design and execution were not followed precisely. The changes of failure are less with high tensile reinforcement as compared to ordinary mild steel.

MECHANICAL ENGINEERING DIVISION

534.01

1. Design, Fabrication and Instrumentation of a Vibration Apparatus for Laboratory Use. S. Dayal, *Associate Member.*

The paper gives the details of a vibration apparatus designed to provide an exercise in the analysis of vibrations and in the use of some transducers for their measurement. The analytical approach as well as the scheme of instrumentation have been explained. The values for amplitude of vibrations, obtained by different methods of measurement, have been compared. The factors, which possibly affect the analytical solution, have also been discussed.

620.194 : 620.171.5

2. Stress Concentration Factor for Curved Beams in Pure Bending with Centroidal Hole. R. C. Ghai, *Non-member,* **and Brajagopal Ghosh,** *Non-member.*

This paper presents the results of an experimental study, employing photoelastic technique, of the effect of centroidal holes on the stresses in plane curved beams of uniform rectangular cross-section subjected to pure bending moment that tends to reduce the curvature. Maximum stress occurs in such members either at the inner fibre of the beam or at the hole boundary near the outer periphery, depending upon the relative hole size and the relative curvature of the beam.

621.165 : 621-762.8

3. Radial Labyrinth Seals for Axial Steam Turbines. A. Jagan Mohan, *Non-member.*

One of the important problems encountered in the design of large capacity steam turbine units operating at high initial steam pressures and temperatures is the efficient design of the high pressure end labyrinth seals. For high initial pressures the length of a conventional labyrinth seal at the high pressure end becomes quite large. In fact it takes up as much as 1.00 to 1.5 meters of the rotor length. This is due to the fact that for a large pressure drop the number of seals required is large and at the same time due to the use of fairly long rotors the pitch of the seals also increases to accommodate the thermal expansion of the shaft. In the case of reaction turbines, of necessity the seals are placed on the periphery of the balance piston the diameter of which depends on the thrust to be balanced. The length occupied by the seals is limited from the manufacturing point of view and hence the percentage loss of steam into the atmosphere is considerable.

The present paper attempts to overcome this difficulty by making use of radial labyrinth seals which, although numerically more in number can decrease the length of the shaft occupied by them as also the percentage of steam lost to the surroundings.

629.113 : 645.41

4. Mechanical Analogue of the Human Body. M. S. Keshav, *Non-member.*

Human bodies are exposed to varying intensities of shock and vibration. These vibrations are harmful to human bodies and their elimination is of considerable importance. In the case of automobiles, moving with changing speeds, jerking due to uneven road surface, quivering of engines etc. originate vibrations which are received at the seats incorporated inside the vehicle. Hence seats should be so designed as to eliminate or at least arrest amplification of these vibrations. The seats, are incorporated after extensive trials with the subjects in position. These requirements depend upon the type of vehicle and till today, there is not enough data to design seats without resorting to actual tests. This paper deals with some initial work in formulating an analogue for the human body which when complete can be used to design seats on a rational basis.

621.9.001

5. Statistical Approach to Chip Thickness Measurement. N. A. Pradyumna Rao, *Non-member,* **and S. C. Das,** *Member.*

Chip thickness ratio has long been recognised to be a basic parameter in the mechanics of metal cutting. The conventional weight method for the measurement of cut chip thickness is time consuming and tedious. In this paper it has been statistically shown that the use of a ball point micrometer for the measurement of the cut chip thickness, modified by a suitable multiplying factor, gives a ready, equally accurate and a satisfactory method.

621-71

6. Heat Transfer from a Disk with Uniform Wall Heat Flux Rotating in Air. B. K. Subba Rao, *Non-member.*

Heat transfer from a disk with uniform wall heat flux rotating in air has been experimentally investigated upto a rotational Reynolds number of

10'. The test disk has an unheated central core, the effect of which has been accounted for by a configuration factor. The results have been correlated in terms of Nusselt and Reynolds numbers for both laminar and turbulent flow. In the case of a completely heated disk, they are given by NNu = 0.386 NRe0.5 (Laminar), and NNu = 0.0148 NRe0.8 (Turbulent). Heat transfer data obtained under uniform wall heat flux indicate that the heat transfer data is not sensitive to the wall boundary condition. The influence of the unheated central core is greater in the case of laminar flow than it is for turbulent flow.

620.75

7. Limit Torque for Bars with Cross-Section Bounded by Two Arcs. N. K. Das Talukder, *Non-member.*

Limit torque of bars with cross-section bounded by two arcs have been derived in terms of the relative eccentricity and radii of the arcs, taking ideally rigid-plastic, homogeneous and isotropic material obeying either Tresca or Mises criterion of yielding. When eccentricity is less the arcs become full circles and the case is of a cylindrical bar with eccentric hole; the analysis covers the full range.

8. Reading. of Indian Standards for Limits and Fits. K. D. Sharma, *Associate Member.*

This paper envisages to establish a correspondence between old British and Indian Standards so that the student and the teacher of engineering can perceive clearly the type of fit that can be obtained by assigning tolerances according to Indian Standard.

INDUSTRIAL ENGINEERING GROUP

1. Programming by Network Analysis. T. S. Vedagiri, *Member.*

Network analysis is one of the techniques of operations research which has come to forefront in the recent past. PERT, CPM, etc., are but variations of the principle of network analysis. The paper deals with the application of the principle in a number of construction, maintenance and capital repair works in the Bhilai Steel Plant. Programming of works on the basis of network leads to logical fixation of time limit for works and identification of bottlenecks well in advance, so that remedial measures could be taken on time. The paper also explains how throughly such analysis, planning of man power and equipment could be effectively carried out. A few of the monitoring methods for proper feed-back of information have been discussed. The paper concludes with answers to some of the common doubts and misconceptions regarding the technique and its application. A detailed treatment of the principle is given in the annexure to the paper for the benefit of those not fully acquainted with it.

MINING AND METALLURGY DIVISION

669.715.00

1. Lattice Spacing Measurement of Aluminium Nickel Dilute Solid Solution at Elevated Temperatures. R. Sharan, *Non-member.* **and Raj Narayan,** *Non-member.*

The paper reports the lattice spacings of Aluminium-Nickel dilute solid solution in equilibrium at elevated temperature. Unichem high temperature camera was used for taking x-ray photographs. The camera was calibrated for mean specimen temperature, as well as for knife edge. Nelson Riley extrapolation method was used for the precision determination. The results are discussed with reference to previous work, solid solubility, and formation of vacancies at elevated temperature.

622.343

2. **Copper Mining in India. Prof. H. K. Bose,** *Associate Member.*

Copper Mining is an ancient vocation in India and Copper has been worked for the last 4000 years. The mining of copper has, therefore, been divided into two categories, *viz.*, ancient and modern, and explained in that order.

INSTITUTION NOTICES

MEMBERSHIP PROMOTION IN THE INSTITUTION

The Institution is a growing organization alive to the needs of the country and the urge of the engineer to know more and more about the developments taking place all over the world in his branch of engineering. Measured in numbers, the Corporate Membership has moved up from 15,904 in 1956 to 55,447 in 1966. This rate of growth is making it increasingly difficult to maintain uniform standards for election. With a view to achieve this uniformity, cooperation is solicited of all Corporate Members who are requested to keep in mind the following simple guidelines while supporting applications for Corporate Membership. This will not only save some likely embarrassment to well-intentioned member in case of rejection but will also preclude the possibility of a deep and abiding ill-will towards the Institution on the part of the disappointed candidate.

1. No candidate should be encouraged to apply if he does not clearly fulfil the requirements as given in the Instruction Sheet attached with each application form.

2. High pressure selling techniques to attract new members should be avoided and the candidate should be allowed to apply without concern.

3 Depending on the promptness of the Centre concerned and the time taken in scrutiny, verification, etc., at the Headquarters, the final disposal of an application for Associate Membership may take from two to four months time. The should be made clear to candidates.

4. 'Position of responsibility' in the profession of engineering may, in general, be taken to start from the post of Assistant Engineer (Junior Engineer for States in Southern parts of the country) in Government Departments, 2nd Lt. in the Army; Lt. in the Navy; Pilot Officer in the Air Force; Assistant Lecturer in Engineering Colleges; Lecturer in Polytechniques; and equivalent posts in other organizations.

5. 'Position of High Responsibility' (Bye-law 14) may, in general, be taken to start from the post of Superintending Engineer of good standing in Government Departments; Lt.-Col. in the Army;. Cdr. in the Navy; Sqn.-Ldr. in the Air Force; Professor in Engineering College; Principal in Polytechnics; and equivalent posts in other organizations.

6. Section C Examination is not compulsory. Only those applicants for Associate Membership are required to appear in this examination whose experience, in the opinion of the Council, is not adequate for direct election as Associate Member. The final decision in this regard rests entirely with the Council.

7. Every application for membership **must** be supported by the requisite number of Members and Associate Members of this Instruction only. This requirement cannot be relaxed under any circumstances.

8. An applicant for Associate Membership or Graduateship **must** have an engineering degree or diploma recognized by the Council for exemption from Sections A and B of the Associate Membership Examination of this Institution. An applicant may have other degrees or diplomas or membership of other professional bodies recognized by the Government or other organizations or institutions; but if these are not recognized by the Council of this Institution, as stated above, the application cannot be accepted by the Headquarters.

9. For an application for Associate Membership to be acceptable the candidate must have (i) either a minimum experience of four years in the engineering field in a position of responsibility after obtaining a recognized degree or diploma (see item 8), or he must have a total experience of seven years in the engineering field in a position of responsibility, inclusive of the time spent in obtaining the said recognized degree or diploma.

10. It is not essential for a candidate for full Membership to have a recognized degree as above provided he fulfils other conditions of Bye-law 14.

11. Where an applicant has experience in the engineering field in a position of responsibility for 15 years or more he is likely to be considered favourably for full Membership provided he is holding a position of high responsibility in the engineering field (see item 5).

12. The final decision regarding the election rests entirely with the Council and this decision will be binding on the applicant.

Draft Indian Standards

The following draft Indian Standards have been issued recently.

1. Draft Indian Standard Specification for Drafting Chairs—Doc : BDC 1 (1136).

This standard relates to chairs for draughtsmen for use with drafting stands and reference tables.

2. Draft Indian Standard Specification for Drafting Tables and Reference Tables—Doc : BDC 1 (1187).

This standard relates to drafting tables and reference tables for draughtsmen and detailed dimensions and general requirements.

3. Draft Indian Standard Specification for Drafting Stool Metals—Doc : BDC 1 (1217).

This standard lays down the requirements for materials, sizes, construction and finish of metal stools.

Members may send their comments on these draft standards before March 25, 1967, to Shri T. R. Mehandru *(M.)*, 14 Asaf Ali Road, Ajmeri Gate Extension, New Delhi, who is the Institution representative on the Sectional Committee dealing with these standards.

4. Draft Indian Standard Code of Practice for Finishing of Wood and Wood-based Materials : Part 1—Operations and Workmanship—Doc : BDC 34 (430) ; and Part 2—Schedules—Doc : BDC 34 (1145).

This code deals with the finishing of wood and wood-based materials.

Members may send their comments on this draft code before March 25, 1967, to Prof. D. K. Dutt (*A.M.*), Chemical Engineering Department, College of Engineering and Technology, Jadavpur University, Calcutta 32, who is the Institution representative on the Sectional Committee dealing with this draft code.

5. Draft Indian Standard Methods of Test for Soils : Part 24—Determination of Base Exchnge Capacity—Doc : BDC 23 (904) ; Part 25—Determination of Silica Sesquioxide Ratio—Doc : BDC 23 (943) ; and Part 26—Determination of pH Value—Doc : BDC 23 (942).

This standard lays down the methods for the determination of (i) base (cation) exchange capacity of soils ; (ii) the silica sequioxide ratio in soils ; and (iii) the pH value of soil suspension.

Members may send their comments on this draft standard before April 5, 1967, to Shri C. G. Swaminathan (*A.M.*), Assistant Director, Central Road Research Institute, New Delhi 20, who is the Institution representative on the Sectional Committee dealing with this draft standard.

6. Draft Indian Standard Safety Code for Demolition of Buildings—Doc : BDC 45.

This standard lays down the safety requirements for carrying out safely the demolition of all types of buildings.

Members may send their comments on this draft standard before April 25, 1967, to Prof. R. N. Dogra (*M.)*, Principal, College of Engineering and Technology, New Delhi 16, who is the Institution representative on the Sectional Committee dealing with this standard.

Shilpa Wangmaya Sangraha (Indigenous Technical Literature Museum), Nagpur

The Indigenous Technical Literature Museum was established in 1956 by the Institution of Engineers (India) in the building of the Nagpur Centre of the Institution. Its object was to collect as many ancient books on technical subjects in Sanskrit and other Indian languages that existed in manuscript or printed forms. Besides the above, modern books in English or Indian languages dealing with old Indian architecture, sculpture and other technical subjects were also to be collected. A list of such books collected till December 1958 was published in the *Bulletin* for March 1959. Since then 74 more books have been collected and added in the Museum An up-to-date list of books is given below for information of members.

1. Agriculture and Allied Arts in Vedic India. A. K. Yagnarayan *Bangalore Press, Bangalore,* Rs. 3.00. 1949. 65 pages.

2. The Economic History of India under British Rule. Ramesh Dutt. *Routledge & Kegan Paul, London,* Rs. 20.00. 1956. 435 pages.

3. A History of Indian Shipping. R. K. Mukherjee. *Orient Longmans Ltd.,* Rs. 20.00. 1957. 206 pages.

4 The Cambridge History of India: Vol. 1. Ancient India.. E. J. Rapson.

S. Chand & Co., Delhi, Rs. 35.00. 1955. 684 pages.

5. The Development of Hindu Iconography. J. N. Banerjee. *Published by the University of Calcutta,* Rs. 30.00. 1956. 651 pages.

6. A Study on *Vastuvidya.* T. Bhattacharya. *United Press Ltd., Patna,* Rs. 16.00. 1947. 370 pages.

7. A History of Sanskrit Literature. A. B. Keith. *Oxford University Press, London,* Rs. 22.50. 1953. 575 pages.

8. The Sacred Books of the Buddhists: Vol. 2. Max Muller. *Luzac & Co., Ltd., London,* Rs. 6.00. 1956. 334 pages.

9. Buddhist India. T. W. Rhys-Davis. *Sushil Gupta India Ltd., Calcutta,* Rs. 6.00. 1957. 200 pages.

10. *Yantras* or Mechanical Contrivances in Ancient India. V. Raghavan. *Published by the Indian Institute of Culture, Bangalore,* Rs. 2.00. 1956. 33 pages.

11. Origin of South Indian Temple. N. Venkataramanayya. *Methodist Publishing House, Madras,* Rs. 15.13. 1930. 70 pages.

12. Political History of Ancient India. H. Roy Chowdhari. *Published by the University of Calcutta,* Rs. 20.00. 1953. 680 pages.

13. Encyclopædia of Hindu Architecture: Vols. 6 and 7. P. K. Acharya. *Oxford University Press, London,* Rs. 42.00. 1946. 508 and 684 pages respectively.

14. The Hindu Temple: Vols. 1 and 2. S. Kramrisch. *Published by the University of Calcutta,* Rs. 90.00. 1946. 295 and 466 pages respectively.

15. India—Paintings from Ajanta Caves. *Published by the New York Grafic Society by arrangement with the U.N.E.S.C.O.,* Rs. 85.00. 1954. 32 pages.

16. Somnath—the Shrine Eternal. K. M. Munshi. *Published by Somnath Board of Industries,* Rs. 5.00. 1951. 117 pages.

17. Indian Architecture—Buddhist, Hindu and Islamic: Vols. 1 and 2. P. Brown. *B. D. Taraporewala, Sons & Co., Ltd., Bombay,* Rs. 50.00. 1956. 500 and 407 pages respectively

18. The Art of India Through the Ages. S. Kramisch. *Phaidan Press, London,* Rs. 30.24. 1955. 411 pages.

19. Temples of North India. *Published by the Tourist Division, Ministry of Transport and Communications, Government of India,* Rs. 1.50. 1956. 39 pages.

20. The Immortal India. A. Nawrath. *B. D. Taraporewala, Sons & Co., Ltd., Bombay,* Rs. 34.00. 1956. 148 pages.

21. The Art of Rashtrakutas. O. C. Ganguly and A. Goswamy. *Orient Longmans Ltd.,* Rs. 32.00. 1956. 50 pages.

22. The Art of Chandelas. O. C. Ganguly and A. Goswamy. *Rupa & Co., Calcutta,* Rs. 32.00. 1957. 3½ pages.

23. *Lalitkala.* K. Khandalawala and Dr. Moti Chandra. *Published by Lalitkala Academy, New Delhi,* Rs. 16.00. 1956. 161 pages.

24. Golden Age of Indian Art. P. Rambach and V. DeGolish. *D. B. Taraporewala, Sons & Co. Ltd., Bombay,* Rs. 31.00. 1955. 180 pages.

25. The Hindu View of Art. Mulk Raj Anand. *Asia Publishing House, Bombay,* Rs. 18.00. 1956. 128 pages.

26. Epics, Myths and Legends of India. P. Thomas. *D. B. Taraporewala, Sons & Co., Ltd., Bombay,* Rs. 25.00. 11th edition. 212 pages.

27. *Kama Kalpa.* P. Thomas. *D. B. Taraporewala, Sons & Co., Ltd., Bombay,* Rs. 34.00. 8th edition. 143 pages.

28. Hindu Canons of Iconography. Dr. D. N. Shukla. *Vastu Vangmaya Prakashana Shala, Lucknow,* Rs. 18.00. 1958. 396 pages.

29. Hindu Canons of Painting—Vol. 9, Pt. 3. Dr. D. N. Shukla. *Vastu Vangmaya Prakashana Shala, Lucknow,* Rs. 9.00. 1958. 188 pages.

30. *Bharatiya Murtikala* (Hindi). Krishnadas. *Published by the Nagiri Pracharani Sabha, Kashi,* Rs. 3.00. 1952. 153 pages.

31. *Bharat ki Chitrakala* (Hindi). Krishnadas. *Published by Bharati Bhandar, Prayag,* Rs. 8.00. 1950. 105 pages.

32. *Bharatiya Vastukala* (Hindi). P. Gupta. *Published by the Nagari Pracharani Sabha, Kashi,* Rs. 2.00. 1956. 150 pages.

33. *Shilpa Katha* (Hindi). N. Vasu. *Hindi Sahitya Press, Allahabad,* Rs. 1.25. 1952. 78 pages.

34. *Sartha-Vaha* (Hindi). Dr. Moti Chandra. *Published by the Bihar Rashtra Bhasha Parishad, Patna,* Rs. 11.00. 1953. 240 pages.

35. *Bharatiya Vastushastra—Granth 4: Pratima Vigyan* (Hindi). Dr. D. N. Shukla. *Vastu Vangmaya Prakashana Shala, Lucknow,* Rs. 15.00. 1956. 254 pages.

36. *Bharatiya Vastushastra: Vastuvidya* and *Puranivesh* (Hindi). Dr. D. N. Shukla. *Vastu Vangmaya Prakashana Shala, Lucknow,* Rs. 8.50. 1955. 342 pages.

37. *Bharatiya Vastushastra: Hindu Prasada* (Hindi). Dr. D. N. Shukla. *Vastu Vangmaya Prakashana Shala, Lucknow,* Rs. 3.00. 1958. 110 pages.

38. *Vasturatnawali* (Hindi-Sanskrit). A. Jha. *Published by Jai Krishnadas & Haridas Gupta, Vidya Vilas Press, Banaras,* Rs. 2.50. 1949. 215 pages.

39. *Vasturatnakar* (Hindi-Sanskrit). V. P. Dwivedi. *Published by the Chowkhamba Sanskrit Society, Banaras,* Rs. 3.00. 1955. 200 pages.

40. *Vastusarni* (Hindi-Sanskrit). M. P. Pande. *Published by B. N. Yadhav, Khelarilal & Sons, Banaras,* Rs. 3.00. 1908. 154 pages.

41. *Shatpanchasika* (Sanskrit-English). V. S. Shastri. *Vijayalakshmi Press, Bangalore,* Rs. 1.25. 1941. 74 pages.

42. *Deeghnikay: Pt.* 2 (Marathi). C. V. Rajwade. *Published by the Granth Prakasha Mandali, Bombay,* Rs. 2.50. 1932. 600 pages.

43. *Vidurnitimalokprasidham* (Sanskrit). G. S. Shastri. *Nirnaya Sagar Press, Bombay,* Re. 0.62. 1935. 64 pages.

44. *Yantra Raj Rajah—Yantra Shiromani* (Sanskrit). *Nirnaya Sagar Press, Bombay,* Rs. 2.00. 1936. 117 pages.

45. *Goladhaya:* Vol. 1 and 2 (Sanskrit). C. Apte. *Published by Anandashram Mudranalay,* Rs. 3.75 and Rs. 5.00. 1943 and 1952. 238 and 528 pages respectively.

46. *Aparajitapraccha* (Sanskrit). B. Bhattacharyya. *Published by Oriental Institute, Baroda,* Rs. 20.00. 1950. 613 pages.

47. *Manasollas:* Vol. 2. (Sanskrit). B. Bhattacharyya. *Published by Oriental Institute, Baroda,* Rs. 8.00. 1939. 304 pages.

48. *Kashyap Shilpam* (Sanskrit). V. G. Apte. *Published by Anandashram Mudranalay,* Rs. 4.75. 1926. 274 pages.

49. *Lilawati.* Vol. 1 and 2 (Sanskrit). V. G. Apte. *Published by Anandashram Mudranalay,* Rs. 4.75. 1937. 125 and 295 pages respectively.

50. *Bhaskariya Bijganitam* (Sanskrit). V. G. Apte. *Published by Anandashram Mudranalay,* Rs. 2.00. 1930. 207 pages.

51. *Graha Ganitadhyay:* Vols. 1 and 2 (Sanskrit). V. G. Apte. *Published by Anandashram Mudranalay,* Rs. 6.50. 1939 and 1941. 176 and 236 pages respectively.

52. *Ratna Dipika—Ratna Shastram* (Sanskrit). T. Chandrashekharan. *Madras Oriental Series, Government of Madras,* Rs. 2.25. 1951. 54 pages.

53. *Krishishashanam* (Sanskrit). R. Raghoba. *Marwari Press, Nagpur,* Rs. 3.00. 1920. 207 pages.

54. *Shukraniti* (Sanskrit). Mihirchandji. *Published by Khemraj Krishna Das, Bombay,* Rs. 4.50. 1956. 192 pages.

55. *Varahi Vrihit Samhita* (Sanskrit). B. P. Mishra. *Published by Khemraj Krishna Das, Bombay,* Rs. 9.00. 1955. 440 pages.

56. *Vaikhansagama* (Sanskrit). K. Sambasivan Shastri. *Government of Travancore,* Rs. 2.37. 1935. 232 pages.

57. An Alphabetical Index of Sanskrit Manuscripts in Government Oriental Manuscript Library, Madras: Vols. 1, 2 and 3. S. K. Shastri. *Published by the Superintendent, Government Press, Madras,* Rs. 6.87, Rs, 5.00 and Rs. 1.69. 1938, 1940 and 1942. 609, 340 and 290 pages respectively.

58. Contribution to a Bibliography of Indian Art and Aesthetics. H. Mitra. *Vishwabharti Publishing Department, Calcutta,* Rs. 12.00. 1951. 240 pages.

59. *Vishwakarma Prakasha Bhashatikayutah.* Rs. 3.50. *Published by Khemraj Krishna Das, Bombay.* 1953-54.

60. *Bharatiya Vastushastra—Granth 4, Bhag 2: Pratima Vigyan—Pratima Lakshanam* (Sanskrit). Dr. D. N. Shukla. *Published by Vastu Vangmaya Prakashana Shala, Lucknow,* Rs. 12.00. 1958. 294 pages.

61. The Palaeography of India. Rai Bahadur Pandit G. S. Ojha. *Munshiram Manoharlal Oriental & Foreign Book Sellers & Publishers, Delhi,* Rs. 75.00. 200 pages.

62. Homage to Khajuraho. M. R. Anand and Stella Karamrich. *Marg Publication, Bombay,* Rs. 10.00. 53 pages.

63. The Art of Indian Asia: Vols. 1 and 2. H. Zimmer. *Kingport Press, Inc. Tennessee,* U.S.A., Rs. 150.00. 465 pages and 614 pages respectively.

64. Ajanta, Ellora, and Aurangabad Caves. R. S. Gupta and B. D. Mehajan. *D. B. Taraporewala Sons & Co., Bombay,* Rs. 70.00. 228 pages.

65. A History of Fine Art in India and Ceylon. V. A. Smith. *D. B. Taraporewala Sons & Co., Bombay,* Rs. 80.00. 200 pages.

66. Many Golden Ages, Ruins, Temples and Monuments of the Orient. F. Macshane Charles. *E. Tuttle Company, Rutland,* Rs. 35.00. 264 pages.

67. Orissan Sculpture and Architecture. O. C. Gangooly. *Oxford Book and Stationery Co., Colcutta,* Rs. 32.00. 22 pages.

68. The Design Development of Indian Architecture. C. Batler. *D. B. Taraporewala Sons & Co., Bombay.* 52 pages.

69. Saga of Indian Sculpture. K. M. Munshi. *Bharatiya Vidya Bhavan, Bombay.* Rs. 10.00. 81 pages.

70. India Temple Sculpture. K. M. Munshi. *Rupa & Co., Bombay,* Rs. 36.00. 48 pages and 141 plates.

71. India Temples and Sculpture. L. Fredieric. *Thomas and Hudson, London,* Rs. 95.00. 464 pages.

72. *Manasar* on Architecture and Sculpture—Sanskrit Text and Critical Notes. Dr. P. K. Acharya. *Oxford University Press,* 845 pages.

73. Architecture of Manasar—Illustrations of Architectural and Sculptural Objects. Dr. P. K. Acharya. *Oxford University Press,* 70 pages and 157 folded sheets.

74. Manasar on Architecture and Sculpture. (English Translation). Dr. P. K. Acharya. *Oxford University Press,* 802 pages.

75. Some Ancient Cities of India. S. Pigott. *Oxford University Press, London, Rs. 4.00.* 100 pages.

76. The Kashmir Series of Texts and Studies No. LXXII—The Prasadamandanam: Sutradhar Mandana. *Shri Durga Press, Srinagar,* 43 pages.

77. Ancient India. M. Elphinstone. E. B. Cowell. W. W. Hunter and J. T. Wheeler. *Susil Gupta (India) Ltd., Calcutta,* Rs. 4.50. 160 pages.

78. The English-Indian Dictionary of Scientific Terminology. Y. *R. Date* and C. G. Karve. *Maharashtra Kosha Mandal Ltd., Poona,* Rs. 40.00. 630 pages.

79. The Art and Architecture of India—Buddist, Hindu and Jain. B. Rowland. *Richard Clay & Co., Ltd., Bangoy suffolk,* 480 pages.

80. The Positive Science of the Ancient Hindus. Brajendranath Seal. *Motilal Dass, Publisher & Booksellers, Patna,* 1958. Rs. 15.00. 295 pages.

81. Gupta Art. V. S. Agrawala. Published by the U.P. Historical Society, Lucknow, 1948. Rs. 5.00. 38 pages.

82. A Survey of Indian Sculpture. S. K. Saraswati. - *K. L. Mukhopadhaya, Calcutta,* Rs. 20.00., 200 pages.

83. Indian Architecture. B. L. Dhama. *Oxford Book & Stationery Co., Calcutta, Rs. 12.50.* 10 pages and 34 plates.

84. Studies in Sanskrit Texts on Temple Architecture (English and Sanskrit). N. V. Mallayar. 1948. Rs. 10.00. 354 pages.

85. *Prasada Mandanam* and *Rajavallabha Mandanam.* (Sanskrit) Sutradhara Mandan. *Metropolitan Printing and Publishing House Ltd., Calcutta,* 1948. Rs. 10.00. 127 pages.

86. *Atharva Veda Samhita* (Sanskrit). Vols. 1-8. K. P. Ramchand Sharma. *Sanatan Dharma Yantralaya, Moradabad.*

87. *Manasar Vastushastra* (Hindi) (Three Copies). Brij Mohan Lal. Published by the Institution of Engineers (India), Calcutta, 145 pages.

88. *Abhilashitarathachintamani* of Someswara Deva (Sanskrit)—Pt. 1. Dr. R. Sharma Sastry. Published by the Government Branch Press, Mysore, 1926. Rs. 2.00. 396 pages.

89. *Sulabh Vastushatra* (Hindi). R. S. Deshpande, Rs. 4.00. 439 pages.

90. *Ayurvad ka Itihas* (Hindi and Sanskrit)—Kaviraj Suramchand. Published by Kaviraj Suramchand, Simla, Rs. 8.00. 300 pages.

91. *Bharatiya Krishi Vigyan* (Hindi) and Sanskrit). C. Mishra. *Shri Prabhakar Sahityaloka, Lucknow,* Rs. 7.50. 492 pages.

92. *Grah Bhagvan Nirmankala.* Ramawtar Veer. *Dehati Book Depot, Delhi,* Rs. 10.00. 284 pages.

93. *Viswakarma Vastusastram* (Sanskrit). K. V. Sastri and Maj. N. B. Gadre. Published for the Administrative Committee of the T. M. S. S. Library, Tanjore, Rs. 15.00. 819 pages.

94. Indian Architecture—vol. 1. A. V. T. Iyer. *A. V. T. Iyer & Sons, Madras,* Rs. 50.00. 272 pages.

95. Indian Architecture—vol. 2. A. V. T. Iyer. *A. V. T. Iyer & Sons, Madras,* Rs. 50.00. 232 pages.

96. *Bharatiya Vastushastra.* D. N. Shukla. *Vastu Vangmaya Prakashana Shala, Lucknow,* Rs. 8.50. 254 pages.

97. *Bharatvarsh ka Brihad Itihas* (Hindi)—Pt.. 1. Pandit Bhagkat Dutt. *Itihas Prakashan Mandal, New Delhi,* Rs. 16. 338 pages.

98. *Hindu Gaini-Shastra ka Itihas* (Hindi)—Pt. 1. Dr. V. Datt. *Prakashana Bureau, U. P. Government, Lucknow,* Rs. 3.00. 238 pages.

99. *Vastumanikaratnakar* (Sanskrit). Pandit Ramtej. 151 pages.

100. *Deepaarnava* (Sanskrit and Gujarati). *Yeshwantrao Prabha Shankar Sompura Sawrashtra,* Rs. 41.00. 488 pages.

101. *Dehat ki Samasayayen* (Hindi). Vishwambhar Prasad. *Subha Printing Press, Delhi,* Rs. 4.00. 160 pages.

102. *Vastusar Parkaran* (Sanskrit). Thakur Pher. Translated into Gujarati by Pandit Bhagwandas Jain. *Jain Vividgranth Mala, Jaipur,* Rs. 6.00. 248 pages.

103. *Ashwalayangrhyasutram* (Sanskrit). P. G. Ranade. *Anandashram Press, Poona, Rs. 12.00.* 223 pages.

104. *Vrihad Viman Shastra* (Sanskrit. Maharshi Bharadwaj. Translated into Hindi by Arya Muni. *Sarvdeshik Arya Pratinidhi Sabha, Delhi,* Rs. 13.00. 344 pages.

105. *Prasad Mandan* (Sanskrit). Mandan. (Translated into Hindi by Pandit Bhagwandas Jain). Published by B. S. Sharma, Jaipur, 1961. Rs. 16.00. 222 pges.

106. *Narad Samhita* (Astrology) (Sanskrit). Translated into Hindi by Vastiram Sharma. *Khemraj Shrikrishnadas, Bombay.*

107. *Bharat Natya Shastra Men Natya Shalaon ke Roop* (Hindi) (Two copies). Dr. Rai Govind Chandra. *Kashi Printing Press, Varanasi,* Rs. 5.00. 24 pages.

108. *Ved-Vidya-Nidarshan* (Sanskrit-Hindi). B. Datt. *Indian Prakashna Mandal, New Delhi,* Rs. 12.50. 331 pages.

109. *Chalanakalan* (Chapters 1 to 4). Mahemohopadhya Pandit Sudhakar Divivedi. *Master Khelarilal & Sons, Banaras City,* 1914. Rs. 0.75. 75 pages.

110. *Hadappa* (Hindi). K. Shastri. *Atmaram & Sons, Delhi,* Rs. 8.00. 249 pages.

111. *Jai Chambal* (Hindi). Vishnu Datt. *Ajanta Pocket Books, Delhi,* Rs. 8.00. 249 pages.

112. *Bharatiya Jyotish ka Itihas* (Hindi). Gorakh Prasad. *Prakashan Bureau, U. P. Government, Lucknow,* Rs. 4.00. 290 pages.

113. The Science of the *Sulba.* B. B. Datta. *University of Calcutta,* 1932, Rs. 3.75.

114. Ancient India as described by Magasthenes and Arrian. J. W. McCrindle. *Chatterjee & Co., Ltd., Calcutta,* 1926, Rs. 150.00. 227 pages.

115. *Vishnu Dharmottar Mahapurana* (Sanskrit). Vyanketshwar. *Khemraj Shrikrishnadas, Bombay,* 471 pages.

116. Memoirs of the Archaeological Survey of India: No 40 Pallawa Architecture—pt. 3. A. H. Loghurst. *Government of India, Central Publication,* 1930. 23 pages.

117. *Agni Purana*—a Study. Dr. S. D. Gyani. *Chaukhamba Publication,* 1964, Rs. 25.00. 38 pages.

118. Islamic Art and Architecture. E. Kuhnel (German). English translation by Katherine Watson. *G. Bell & Sons Ltd., London,* 1966, Rs. 44.00. 200 pages.

119. Early Chola Art—pt. 1. S. R. Balasubrahmanyam. *Asia Publishing House, Bombay,* Rs. 60.00. 288 pages and 127 plates.

120. Daily Life in Ancient India from 200 B.C. to 700 A.D. (French) Jeannine Auboyer. Translated by Suman Watson Taylor. *Asia Publishing House, Bombay,* 1965. 344 pages.

121. The Flowering of Indian Art. Radha Kamal Mukerjee. *Asia Publishing House, Bombay,* Rs. 50.00. 303 pages and 76 plates.

122. Founders of Sciences in Ancient India. Dr. Satya Prakash. *The Research Institute of Ancient Scientific Studies, New Delhi,* Rs. 60.00. 684 pages.

123. Temples of India. Published by the Department of Tourism, Government of India, 1964, Rs. 15.00. 124 pages.

124. The Heritage of Indian Art. Dr. V. S. Agarwala. Publications Division, Government of India, Delhi, 1964, Rs. 25.00. 186 pages.

125. Studies in the Development of Ornaments and Jewellery in Protohistoric India. Dr. Rai Govind Chandra. Published by Chaukhamba Sanskrit Series Office, Varanasi, 1964. Rs. 75.00. 370 pages and 48 plates.

126. *Pramanamanjari.* Dr. Priyabala Shah (ed.). *Published by the Oriental Institute, Baroda,* 1958, Rs. 2.50. 33 pages.

127. Immortal Khajuraho. Kanwar Lal. *Asia Press, Delhi,* 1965, Rs. 200.00. 253 pages and 234 plates.

128. Splendours of the East. M. Wheeler. *George Weiderfeld and Nicolson, London,* 1965, Rs. 100.00. 288 pages.

129. *Samarangan Sutradhar*—pt. 1. (Sanskrit and Hindi). Dr. D. N. Shukla. *Mehar Chand Lakshman Das, Delhi,* 1965, Rs. 36.00. 500 pages.

130. *Ratnaparikshadi, Sapta-Grantha-Sangraha* (Prakrit-Hindi)—*Thakar Pheru.* Agar Chand and Bhanvar Lal Nahata (ed.). Published by the Rajasthan Oriental Research Institute, *Jodhpur,* 1960, Rs. 9.25. 108 pages.

131. *Varahi (Brihat) Samhita* (Sanskrit-Hindi). Hindi Translation by B. P. Misra. *Khem Raj Sri Krishna Das, Bombay,* 195. 440 pages.

132. Catalogue of Sanskrit Manuscripts in Saraswati Mahal Library, Tanjore—vol. 18. Vidyasagar P. P. S. Sastri. Published by the Administrative Committee, Saraswati Mahal Library, Tanjore, Rs. 2.00. 500 pages.

133. Weekly *Shilpa Sansar.* Major N. B. Gadre. 1955-56, (Three copies.)

134. Culture and Civilization of Ancient India in Historical Outline. D. D. Kosambi. *Routledge and Kegan Paul, London,* Rs. 52.50. 254 pages.

FORTHCOMING EVENTS

Symposium on 'Low Cost Housing', Ranchi, April 7, 1967

The Ranchi Sub-Centre of the Institution is organizing a Symposium on 'Low Cost Housing' to be held on April 7, 1967. Papers, offering real and practical ideas relating to houses for residential purposes, accompanied by drawing sketches and photographs, are invited by the Honorary Secretary of the Sub-Centre.

Further details can be obtained from Shri S. R. K. Roy, Honoray Secretary, The Institution of Engineers (India), Ranchi Sub-Centre, South Officepara, P.O. Hinoo, Ranchi 2.

Seminar on 'Thermal Power Stations', Neyveli, May 12-13, 1967

A Seminar on 'Thermal Power Stations' will be held at Neyveli, Madras State, from May 12-13, 1967. Sponsored by the Neyveli Sub-Centre of the Institution of Engineers (India), Technical Club, Neyveli, and Thermal Power Station, Neyveli Lignite Corporation Limited, the Seminar will deal with the following subjects: (i) Construction and costs of modern thermal power stations; (ii) Design and manufacture of modern thermal power plant equipment; (iii) Standardization of equipment, planning and design of thermal power stations; (iv) Testing, commissioning and initial operation of equipment in steam power stations; (v) Efficiency and generation costs of steam power stations; (vi) Man-power requirements and training of power plant personnel; (vii) Maintenance, major overhauls and repairs of thermal power plant equipment; (viii) Indigenisation of equipment and spare parts for thermal power stations; (ix) Future trends and planning of power development in India; (x) Operational requirements, performance studies, problems in large thermal power plants; (xi) Corrosion, erosion, vibration and wear problems of power plant equipment; (xii) Problem of air pollution and waste disposal in large thermal power plants; (xiii) Control, automation, instrumentation and protection of thermal power plants; (xiv) Water treatment and conditioning for thermal power stations; (xv) Standardization of capital, operation and maintenance, cost accounting methods in thermal power stations; and (xvi) Any other general subjects bearing on thermal power stations.

Further details can be obtained from Shri L. R. Suri, Organizing Secretary, 'Seminar on Thermal Power Stations', Thermal Power Station, Neyveli-1, Madras State.

Summer School in High Voltage Laboratory Techniques, Bangalore, May 8-20, 1967

The research and testing personnel of the laboratory will pass on their experience to electrical and allied industries, electricity boards and university teachers through the summer school to be held during May 8-20, 1967. The course covers basic principles of high voltage production, measurement and testing techniques supported by appropriate experiments and demonstrations. One of the objects of the school is to give those who attend a real working knowledge of high voltage application. Morning sessions will be devoted to theory and demonstrations; laboratory practice lessons will be held in the afternoons. There will be 26 lectures of one hour duration each and 31 hours of laboratory practice to be concluded by a discussion meeting at the end of the course.

Subjects to be covered include: (i) Need for H. V. Testing, Basic Impulse Insulation Levels, Insulation Co-ordination, H. V. Apparatus and Tests; (ii) Behaviour of H. V. Apparatus under Over-Voltage Conditions, due to Switching and Lightning; (iii) Production and Measurement of H. V.—A.C., D.C., Impulse and Switching Surge Voltage; (iv) Specifications and Tests on H. V. Apparatus like Bushings, Power and Instrument Transformers, Cables, Insulator, Isolators, Lightning Arresters; (v) Insulating Materials and their Testing—Classification, Breakdown Characteristics and Dieelectric Properties; and (vi) Treatment and Experimental Data with reference to H. V. Measurements and Testing.

Tution fee is Rs. 500 and is payable upon notification of admission to the Registrar, Indian Institute of Science, Bangalore 12. Further details can be obtained from the Registrar.

Eleventh Indian Standards Convention, Chandigarh, September 25-30, 1967

The Indian Standards Institution has accepted the invitation of the Northern India Chamber of Commerce and Industry to hold the Eleventh Indian Standards Convention at Chandigarh. The Convention will be held during September 25-30, 1967.

Those who wish to participate in the Convention may write for particulars to Shri Kavaljit Singh, Organizing Secretary, Eleventh Indian Standards Convention, Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 1.

Symposium on 'Bulk Handling of Raw Materials', Dhanbad, 1967

A symposium on 'Bulk Handling of Raw Materials' will be held at Dhanbad sometime in the autumn of 1967 under the auspices of the Central Fuel Research Institute. The topics for discussion at the symposium are broadly classified as (i) Loading and unloading of coal, ores, liquid fuels, (ii) Transportation techniques (from source to plant), (iii) Storage for different capacities, (iv) Design of bunkers for different quality and size of raw and ore, and (vii) Pipeline Transportation of solids. Members who wish to contribute papers for discussion at the Seminar should send a summary of their contribution to the organizers immediately.

Further details can be obtained from Dr. A. Lahiri, Director, Central Fuel Research Institute, P.O. F.R.I., District Dhanbad, Bihar.

Southeast Asian Regional Conference on Soil Mechanics, Bangkok, April 24-30, 1967

A Southeast Asian Regional Conference on Soil Mechanics will be held in Bangkok, Thailand, from April 24-30, 1967. Sponsored by the Seato Graduate School of Engineering, the objectives of the Conference are (i) to stimulate interest in the science of soil engineering amongst engineers in the Southeast Asian Region; (ii) to promote the advancement of soil engineering in the region; (iii) to provide an opportunity for engineers, researchers, and educators in the profession to exchange ideas and experiences, to discuss particular problems in the region, and to review and discuss research in soils with particular emphasis on the regional aspect; and (iv) to promote the formation of a Regional Society of Soil Engineering for Southeast Asian countries which do not have a National Society. The technical programme of the Conference will be divided into seven sessions and papers on the following topics will be read and discussed: (i) Regional Soil and Soil Properties; (ii) Soil Properties; (iii) Field Measurement and Construction Methods; (iv) Foundations; (v) Dams and Slopes; (vi) Highway Materials and Stabilization; (vii) Pavement and Unclassified.

Further details can be obtained from Dr. Za-Chieh Moh, Chairman, Conference Committee, Seato Graduate School of Engineering, P.O. Box No. 2574, Bangkok, Thailand.

AIPC Symposium on 'Design Philosophy and Its Application to Precast Concrete Structures', London, May 23-24, 1967

The Cement and Concrete Association, London, on behalf of the Association Internationale des Ponts et Charpentes (AIPC) is arranging a Symposium on 'Design Philosophy and Its Application to Precast Concrete Structures in London' from May 22-24, 1967. The Conseil Internationale du Batiment pour la Recherche l'Etude et la Documentation (CIB), the Comite European du Beton (CEB) and the Federation Internationale de la Precontrainte (FIP) are collaborating by making available the work of their Commissions as the basis of special reports to be presented at the Symposium. The Symposium will aim to establish the basic design characteristics for precast concrete construction with regard to both structural elements and the structure as a whole. Research and construction problems will be reviewed but it is not proposed to include pure architectural considerations in the discussion. The scope of the proceedings will cover the whole range of building and civil engineering structures.

Further details can be obtained from The Organizing Secretary, AIPC Symposium on Design Philosophy and Its Application to Precast Concrete Structures, Terminal House, Grosvenor Gardens, London, S.W.1.

Conference on 'Frequency Generation and Control for Radio System', London, May 22-24, 1967

A conference on 'Frequency Generation and Control for Radio System' will be held at the Institution of Electrical Engineers, London, from May 22-24, 1967. The meeting is sponsored jointly by the IEE Electronics Division, the Institution of Electronic and Radio Engineers, and the Institute of Electrical and Electronics Engineers (U.K. and Eire Section). The scope of the conference will include:

Sources: Atomic sources (fixed and portable); crystals; measurement and correction

Control and derivation of frequency: System requirements; synthesizers and analysers; phase and frequency locking and tracking systems

Applications: Communication systems; navigation and position finding systems; surveying; test equipment

Registration forms and further details will be available from the Joint Conference Secretariat, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

1967 Congress of Canadian Engineers, Montreal, May 29-June 2, 1967

The 1967 Congress of Canadian Engineers will be held at the site of the 1967 World Exhibition in Montreal, Canada, from May 28-June 2, 1967. Papers on the following topics will be discussed during the Congress: (i) Frontiers in the Seventies; (ii) Water Resources and Climate Control; (iii) Nuclear Opportunities; (iv) Movement of Materials; (v) Movement of Information; (vi) Systems Engineering—a New Discipline for an Old Need; (vii) Systems Engineering in Telecommunications; (viii) Systems Engineering in Industry; (ix) Systems Engineering in Defence; (x) The Machine Man Interface; (xi) Increased Productivity; (xii) New Materials; (xiii) Action and Knowledge; (xiv) Project and Problem Engineers; (xv) The Engineer and His Future; (xvi) The Engineer in Society; (xvii) Canada and Other Peoples; (xviii) Snow and Ice, (xix) Natural Resources; (xx) Space Engineering; (xxi) Aero Engineering; (xxii) Forest and Agricultural Engineering; (xxiii) Energy Resources and Conservation; (xxiv) Planning and Costs; (xxv) Communications and Electronics; (xxvi) The Engineering of Large Structures; (xxvii) Computer Developments; (xxviii) Control of Complex Transportation System; (xxix) Research Findings; (xxx) Design Engineering; and (xxxi) Exotic Vehicles.

Further details can be obtained from L. M. Nadeau, Joint Secretary, 1967 Congress of Canadian Engineers, 116 Albert Street, Sivte 401, Ottawa, Ontario, Canada.

Second IFAC/IFIP International Conference on 'Digital Computer Application to Process Control', Menton, June 5-9, 1967

The Second IFAC/IFIP International Conference on 'Digital Computer Application to Process Control' will be held in Menton, France, from June

5-9, 1967. The technical programme of the Conference consists of six sessions each dealing with (i) Chemical Industry; (ii) Power Systems; and Thermal and Nuclear Power Stations; (iii) Iron and Steel Industry; (iv) Transportation; (v) Various Applications; and (vi) Survey Papers.

Further details can be obtained from Second IFAC/IFIF International Conference Secretary's Office: AFRA, 5 rue de Leige, F-75, Paris 9e.

Conference on 'Magnetic Materials and Their Application', London, September 26-28, 1967

A Conference on 'Magnetic Materials and Their Applications' will be held at the Institution of Electrical Engineers, London, from September 26-28, 1967. The Conference is sponsored jointly by the Institution of Electrical Engineers, the Institute of Physics and the Physical Society, and the Institute of Electrical and Electronics Engineers (U.K. and Eire Section). Topics to be discussed will include the preparation, properties and applications of all forms and types of hard and soft magnetic materials. The applications concerned will be those in which the choice of the particular magnetic material is important. The physical theory of magnetism will not be included. The Organising Committee invite the submission of contributions of up to 1,500 words for consideration for inclusion in the conference programme.

Registration forms and further details will be available from the Joint Conference Secretariat, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

Conference on 'The Economics of Reliability of Supply', London, October 9-12, 1967

A conference on 'The Economics of Reliability of Supply', organized by the Power Division of the Institution of Electrical Engineers, will be held in London from October 9-12, 1967. The conference will compare standards adopted in various countries and will cover generation, transmission and distribusion. It will emphasize the economics of different standards of reliability, as well as their influence on the planning and design of overall supply systems. Sessions will include performance, cost of failures, quality of supply, economics of scale, special supply arrangements, and local generation compared with long distance transmission.

Registration forms and further details will be available a few months before the date of the conference from the Secretary, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

Conference on 'Engineering and Apparatus for Modern Electricity Supply Tariffs' London, October 30-November 1, 1967

The Institution of Electrical Engineers are arranging a three-day conference on Metering and Apparatus for Modern Electricity Supply Tariffs to take place in London from October 30-November 1, 1967. Since the meter is midway in the commercial transaction between supplier and consumer it is natural that subjects associated with accountancy will be included such as consideration of the reasons for the use of prepayment meters and their possible elimination by use of shorter billing periods made possible by remote meter reading and data processing. Tariffs and their effect on the production of a wide variety of types of meter will be subjects covered. Greatest interest will no doubt centre on the design and production of metering and ancillary equipment as well as standards of measurement. However, the statutory aspects in the U.K. and other countries will be considered and their control over the removal of meters for retesting.

The Organizing Committee invite the submission of contributions of up to 1,500 words for consideration for inclusion in the Conference programme. Those wishing to offer material are invited to submit synopses of about 200 words as soon as possible.

Further details, with a list of subjects to be covered, are available from the Secretary, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

National Symposium on 'Ground-Water Hydrology', San Francisco, November 6-8, 1967

A National Symposium on 'Ground-Water Hydrology' will be held in San Francisco, California, U.S.A., on November 6-8, 1967, sponsored by the American Water Resources Association, the symposium will be divided into four sessions: (i) Occurrence of Ground Water in different geologic environments, (ii) Ground-water movement and well hydraulics, (iii) Sea-water intrusion, artificial recharge, and surface water-ground relationships, and (iv) Model and radioisotope techniques in ground-water resources investigations.

Further details may be obtained from: Programme Chairman, Symposium, American Water Works Association, P.O. Box 434, Urbana, Illinois 61801, U.S.A.

Conference on 'Electrical Methods of Machining and Forming', London, December 5-7, 1967

A Conference on 'Electrical Methods of Machining and Forming' will be held at the Institution of Electrical Engineers, from December 5-7, 1967. The scope of the Conference will be: Electron beam machining methods; Spark erosion and plasma methods; Electrochemical methods; Laser machining; and Any associated problems connected with materials behaviour. The organising committee invite the submission of contributions for consideration for inclusion in the conference programme.

Further details, with a list of subjects to be covered, are available from the Conference Section, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

Second International Symposium on 'System Sensitivity and Adaptivity', Dubrovnik, August 1968

The Yugoslav Committee for Electronics and Automation, under the sponsorship of the IFAC Theory Committee, will organize the Second International Symposium on 'System Sensitivity and Adaptivity, in Dubrovnik, Yugoslavia, in August 1968. The following topics are suggested for submission of papers.

(i) Sensitivity Operators and Sensitivity Models for Parametric and Functional·Variations. Effects of Structural Changes: Changes in

System Order, Discretization Sensitivity for Lumpex and Distributed Parameter Systems. Applications to Error Analysis.

(ii) Systems with Stochaistic Parameters. Sensitivity of a Large Scale System with Respect to a Change in a Part of the System.

(iii) Comparison Sensitivity for Open and Closed Loop Design. Parameter Invariance, Uncontrollability and Insensitivity Conditions.

(iv) Synthesis of Optimal Systems with Limited or Minimum Sensitivity. Including the Sensitivity Criteria in System Optimization (Examples).

(v) Sensitivity Problem in Passive and Active Network Synthesis and Integrated Circuit Design.

(vi) Sensitivity Model as a Tool for Iterative Optimization Procedures in Parameter and Functional Spaces. Simultaneity Problem in Obtaining Sensitivity Functions and Gradient Components. Applications of Sensitivity Method in System Identification.

(vii) Adaptive Control of Incompletely Defined Plants, Compatibility of Adaptive Controllers. Adaptive Systems and Reduction of Necessary a priori Information. Application of Sensitivity Models and Sensitivity Minimization in Model-Reference Adaptive Systems.

Further details can be obtained from the Yugoslav Committee for Electronics and Automation, Beograd, P.O.B. 356, Yugoslavia.

Symposium on 'Wearing Surfaces for Steel Bridge Decks', New York, September 7, 1968

A Symposium on 'Wearing Surfaces for Steel Bridge Decks' will be held at the Columbia University, New York, on September 7, 1968. The Symposium will be followed by the next Congress of the International Association for Bridge and Structural Engineering to be held in New York from September 9-14, 1968. In order to enable the reporting members to give a comprehensive survey of the experience of various countries, the German National Group has prepared a questionnaire, copies of which can be obtained from the Technical Secretary, Indian National Group of the International Association for Bridge and Structural Engineering, Jamnagar House, Shahjahan Road, New Delhi 11.

BOOK ACKNOWLEDGMENTS

1. **The Mechanical and Physical Properties of the British Standard En Steels (B.S. 970-1955).** Compiled by J. Woolman and R. A. Mottram. *Pergamon Press Ltd.*, £7.7s., 1966, 488 pages.

The purpose of this volume is to give in one source all useful data on the most commonly used range of steels in the United Kingdom—B.S. 970 En Steels. The information given in this book is from a wide variety of sources, including published literature, works brochure, and test records, both published and unpublished, from many research laboratories. Several laboratories have carried out special tests to obtain properties not previously determined, and various government sponsored organizations have granted permission to extract data from hitherto unpublished reports. A list of references to sources is given at the end of each section. Special attention has been given to incorporating the nearest foreign specification for each steel and the most recently recognized International Standard Symbols have been used for each property in addition to the British designation.

2. **Advances in Materials.** *Pergamon Press Ltd.,* £6, 1966, 270 pages.

This publication contains the papers presented at the Symposium on 'Advances in Materials' organised by the North Western Branch of the Institution of Chemical Engineers, London. Latest Developments in materials science and technology were discussed at the symposium on a broad front and was not restricted to chemical engineering only. The limitations imposed by materials on the progress of modern technology were examined, together with developments to meet the increasingly exacting requirements of industry.

3. **Modulation, Resolution and Signal Processing in Radar, Sonar and Related Systems.** R. Benjamin. *Pergamon Press Ltd.,* 55s. 1966, 184 pages.

In this book are given the latest advances in the radar, sonar and related systems including problems related to Doppler effects, networks, aerials and scanning, etc. In it derivations are given of: (1) important basic concepts and physical principles common to these diversal fields, (2) the concept of a circuit 'matched' to given signal and noise distributions, and (3) the similarities and interrelations between 'resolution' in range, Doppler, azimuth, and elevation, and shows how they jointly depend on the aggregate time bandwidth product of the matched receiving system. The ideas evolved are illustrated by simple block schematics of their practical applications.

4. **Introduction to Electronics.** V. A. Suprynowicz. *Addison-Wesley Publishing Co., Inc.,* $9.50 1966, 324 pages.

This book is interesting and informative in presenting the basic principles of operation for the multitude of modern electronic instruments. Throughout this book electron flow is used rather than conventional current flow. The book is meant to be of help especially to practising scientists in the fields of biology and medicine as well as chemistry.

5. **Encyclopaedic Dictionary of Physics.** J. Thewils (*ed.*). *Pergamon Press Ltd.,* £7, 1966, 404 pages.

This dictionary has been written by international experts in each field of pure and applied physics. The articles defining each term are upto 2,000 words in length and illustrated. The articles are arranged alphabetically with a minimum of cross-references, each article being complete in itself, although references to related topics are appended to the articles with bibliographies for further guidance of the readers.

6. **Continum Mechanics 1—the Mechanical Foundations of Elasticity and Fluid Dynamics.** C. Truesdell. *Gordon and Breach Science Publishers, Inc.,* 1966, 218 pages.

This is one of the four volumes designed to reflect the resurgence of continum mechanics in the past few years. Subject matter published earlier than 1961 is not included in this volume which deals with the 'Mechanical Foundations of Elasticity and Fluid Dynamics'.

7. **Chandigarh.** N. Evenson. *Cambridge University Press,* 128s., 1966.

This book gives the planning and development of the capital city of East Punjab together with a critical picture of the city as it now exists.

This civic project of unusal magnitude was begun in 1950 with the support of the national government. Lack of trained architects and planners was the reason why an American and a Polish architect had to work on the project initially. The project was taken over by French architects Le Corbusier and Pierre Jeanneret, and two British architects in 1951. The plan of Chandigarh wove together the dominant trends in urban design as it had been developing in the West and owed much to both the garden city heritage and Le Corbusier's classical predilections. The present progress of the city with an eye to the future and an evaluation of the present success of the planning effort has been included in the book. Since some of the difficulties and incongruities of imposing an essentially foreign conception of civic design in India the need for development of design standards based on indigenous conditions is stressed.

8. **Handbook for Engineers—vol. 2: Mechanics, Strength of Materials and the Theory of Mechanisms and Machines.** K. P. Yakovlev (*ed.*). *Pergamon Press Ltd.*, 60s. 1966, 609 pages.

This volume 2 of a series of 3 which constitute the 'Handbook for Engineers' deals with mechanics, strength of materials, and theory of functions. The book contains data which constitute a summary exposition of the courses for the subjects in the syllabuses of colleges of technology and other technical institutions of an advanced nature.

9. **Beams on Elastic Foundation.** K. C. Ray. *Orient Longmans Ltd.*, Calcutta, Rs. 15, 1966, 104 pages.

The tables given in this books were published in the *Journal of the Institution of Engineers (India)* and American Concrete Journal. The following characteristics have been presented: (1) Sets of influence lines for shear and pressure distribution; and (ii) Values of the dimensionly parameter. Worked out problems illustrating use of the tables in all possible fields of application have been included. Parabolic interpolation has been subsequently observed to give very good results both with respects to values of 'm' and co-efficients after linear interpolation method proved to give inaccurate results.

10. **A Textbook of Railway Engineering.** P. K. Bhattacharjee and A. K. Basu. *Orient Longmans Ltd.*, Calcutta, Rs. 10.50, 1966, 210 pages.

The subejct is dealt explicitly, profuse illustrations and Railway Boards regularions necessary have been provided, and standard dimensions and summary of questions have been given at the end of each chapter.

11. **A Textbook of Road Engineering.** A. K. Basu and P. K. Bhattacharjee. *Orient Longmans Ltd.*, Calcutta, Rs. 12.50, 1966, 248 pages.

This book covers the text on road engineering in simple language. The special features of this work are illustrative sketches, I.R.C. tables, road signs in their proper colour, working tables and the summary of questions at the end of each chapter.

12. **Practical Engineering Drawing for Industrial Draftsman.** S. D. Mahulikar. *Anath Vidyarthi Griha Prakashan*, Poona, Rs. 9, 1966, 136 pages.

This book is intended for use by all mechanical draftsmen and technical students who desire to make successful career as industrial draftsmen. It contains all data required by draftsmen for the preparation of industrial drawings with standard practice.

13. **Cost Accounting.** B. Murao. *Thacker, Spink & Co., (1933) P. Ltd.,* Calcutta, Rs. 24.00, 1966, 736 pages.

The first part of the book deals with fundamentals of cost accounting in relation to other functions of organization of an enterprise. The next part deals with labour, material and overhead costs, and productivity concepts. The final portion includes assembly, allocation and apportionment of selling, distribution and administrative overhead costs. The cost control aspects—inclusive of the standard cost, cost audit, mechanising of accounts, etc., have been dealt in detail.

14. **Estimating and Costing in Civil Engineering: Theory and Practice.** Prof. B. N. Dutta. Published by the author. 7th edition, Rs. 15, 1966. 742 pages.

This seventh revised and enlarged edition of a book in metric system includes many new examples on estimate of sanitary works of building, septic tank, tube wells, etc. Orientation of buildings and design of road crust on the basis C.B.R. together with C.B.R. curves have been added. Chapters on 'Valuation and Accounts' and 'Procedure of Works' have been revised. Building drawings in metric dimensions and selected questions have been added.

15. **Engireers' Reference Book.** G. C. Tolaney: Published by the author. Rs. 4, 191 pages.

This reference book in metric system contains useful formulae and other information in tabular form intended to aid the memory and to serve as a handy ready reckoner. It will help all those connected with executing of civil engineering works, i.e., engineers, draftsmen and supervisors, and students of civil engineering.

16. **A Textbook of Graphic Statics.** M. Roshan Ali Khan. *Asia Publishing House,* Rs. 8, 1966, 108 pages.

This book in metric system presents the fundamentals of the subject in lucid colours. It deals with copular forces, Centre of Gravity, Moment of Inertia of Areas, Bending Moment, Shear Force, Forces in Plane Framed Structures and Space Frames. Worked out examples and exercises given at the end of each chapter enhances the utility of the book.

PUBLICATIONS RECEIVED

A copy of the 'Annual Report 1965-1966' of the National Metallurgical Laboratory, Jamshedpur, has been received. In this book, details of the research projects carried out and new processes that have been developed in the Laboratory during the year 1965-66 are described.

A copy of a monthly periodical entitled 'Science Today' has been received from Bennett, Coleman & Co. Ltd., Bombay.

A copy of a publication entitled 'Third Symposium on Earthquake Engineering' has been received from the School of Research & Training in

Earthquake Engineering, University of Roorkee, Roorkee. This publication contains the programme of the Symposium held at Roorkee in November 1966 and the General Reports.

A copy of a publication entitled 'Site Investigation for Foundations' has been received from Sahu Cement Service, New Delhi. This publication contains the papers received for a Symposium organized by the Central Building Research Institute to be held at Roorkee in March 1967. Topics for presentation of papers are divided as (i) Organization, Planning and Economies of Site Investigation, (ii) Method and Extent of Investigation, (iii) *In situ* Tests, and (iv) Special Site Investigation for Specific Purposes.

A copy of a publication entitled 'Third Symposium on Earthquake Engineering' has been received from Sahu Cement Service, New Delhi. The Symposium, held at Roorkee under the auspices of the School of Research and Training in Earthquake Engineering in November 1966, dealt with the following topics: (i) Structural Response and Design Structure for Earthquake and Blast Forces; (ii) Soil and Foundation Behaviour During Earthquakes; (iii) Design of Dams and other Appurtenant Works in Seismic Zones; (iv) Wave Propagation, Seismicity and Geological Studies of Tectonic Features Influencing Occurrence of Earthquakes; and (v) Housing in Seismic Zones and during Recent Earthquakes. Papers presented under these topics are given in this volume.

A copy of a publication on 'Marble in Israel' by Asper Shadmon has been received from the Department of Mines, Government of Israel. This report, which is the first in a series of reports on the mineral building commodities of Israel, summarizes the information available at the Quarries Section of the Israel Geological Survey and the Office of the Controller of Mines. Copies of the publication can be obtained from The Department of Mines, P.O. Box 884, Jerusalem, Israel.

A copy of the 'Report for the year 1965' of the Cement and Concrete Association, U.K., has been received. Starting with a brief report, this publication described the research and development projects and advisory work undertaken by the Association.

A copy of a publication entitled 'Practical Recommendations for the Design and Construction of Prestressed Concrete Structures' has been received from the Federation Internationale de la Precontrainte. This publication is the result of a decision made at the 1962 Congress of the FIP to produce a set of international recommendations for prestressed concrete. An FIP-CEB Joint Committee was formed for the purpose, since the two organizations are concerned with the same material concrete.

PERSONALS

DR. S. BHATTACHARYYA, B.Met., M.S. (Met.), D.Eng. (Met.), A.M.I.E., has been appointed Senior Metallurgist and Group Leader of Power Metallurgy at I.I.T. Research Institute, Chicago, U.S.A. Dr. Bhattacharyya first joined the IITRI in 1964 and conducted research in metal wear, friction, and surface effects. He returned to India in 1965 to become Chief Metallurgist of the Bokaro Steel Works.

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here.

Shri V. D. Lad

Shri Vasant Daji Lad, B.Sc., died in a fatal accident in the Central Railway Workshop, Bombay, on August 27, 1966.

Born in 1934, Shri Lad took his B.Sc. degree from the Bombay University in 1956. He also passed the D.M. & E.E. course from the Railway Technical institute in 1959, and was employed as A class Chargeman in Central Railway, Bombay. He joined the Institution as a student in 1958.

Shri H. Ahmed Kabir Khan

Shri H. Ahmed Kabir Khan, B.E., A.M.I.E., died suddenly on January 17, 1967, while accompanying Dr. K. L. Rao and Shri G. A. Narasimha Rao on their inspection of the diversion tunnel gate at the Nagarjunsagar Dam. He was 49.

Born at Villupuram, Madras State, in 1917, Shri Khan obtained his B.E. degree in Civil Engineering from the Madras University in 1940. After having practical training in the Madras P.W.D., he has appointed as Supervisor in the same Department till 1943. Subsequently he worked in various capacities and in 1953 he was posted as Executive Engineer, Kurnool Division. From 1954-55 he worked as Executive Engineer (Construction) in the Electricity Department and was in charge of transmission line construction and structures and buildings. In the following year he was transferred to the Special Division of the P.W.D. at Chittoor. He was also with the Krishna Basin Division of the Central Water and Power Commission in 1957. In 1959 he was sent to the Periyav Investigation Division of the C.W. & P.C. at Ernakulam. In 1961 he became Superintending Engineer in the P.W.D. and was posted at Anantapur. Shri Khan was one of the Senior Engineers of Andhra Pradesh and a great deal was accepted of his professional contribution towards the advancement of flood control problems as also the construction of medium storage reservoirs in the State in connection with food scarcity and prevailing drought.

Shri Khan joined the Institution as Associate Member in 1956.

Shri N. C. Sen

Shri Nirmal Chandra Sen, B.E.E., M.I.E., died in November 1966, at the age of 55.

Born in Dacca in 1911, Shri Sen obtained his B.E.E. degree from the Jadavpur University in 1956. Appointed as an apprentice engineer in the Bengal Electric Lamp Works Ltd. in 1936, he was responsible for the maintenance, production and upkeep of the electric lamp manufacturing plant. In 1946 he was promoted as Assistant Works Manager and two years later he became the Works Manager of the firm. In 1948 he was deputed by the Company to visit the U.S.A. and the U.K. for a short training in the manufacture of incandescent lamps. Being in charge of the research and development departments of the company, Shri Sen had designed and produced two glass melting furnaces to manufacture glass bulbs.

Shri Sen joined the Institution as Member in 1962.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, Industrial and other organisations employing engineers. It is hoped that employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

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Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta, except where otherwise stated.

SITUATIONS WANTED

MECHANICAL ENGINEER, B.Sc. A.M.I.E. (India), aged 32, with specialization in Industrial Refrigeration and Airconditioning, having good experience of maintenance work in chemical industries; also having working knowledge in chemistry, electrical and building construction work and project work; seeks challenging opportunity for erection and maintenance work in chemical or mechanical engineering factories; western India preferred; presently holding a senior position getting around Rs. 1,500.00; interested in large private industrial organizations. (Office ref. E.S. 273)

MECHANICAL ENGINEER, H.N.C. (London), Grad. I.E. (India), age 36, passed with first class marks, 8 years of wide experience in workshop and design of boilers, valves, actuators, structural engineering, production and administration in West Germany, England and in India. Also worked in feasibility reports of plants and piping design; seeks a suitable position. (Office ref. E.S. 277)

STUDENT of the Institution of Engineers (India), young, energetic, ambitious, having experience in malleable and steel foundry; knowing steel analysis, steel making process, induction and cupola furnace operation charts, calculation for alloy steel castings, mouldings, heat treatment, etc.; seeks immediate employment any where. (Office ref. E.S. 278)

AVAILABLE specially qualified and five years experienced pressure die casting die designer in reputable firm in Bombay or Calcutta. (Office ref. E.S. 279)

GRADUATE of the Institution of Engineers (India), aged 26 years, passed diploma in Civil Engineering with first class marks, having 7 years experience in survey work, drawing, estimating of buildings and hydraulic structures like bridges, syphons, etc., construction of heavy R.C.C. foundation and R.C.C. superstructure work, canal excavation work by earth moving machineries, possessing high sense of duty; seeks prospective change in Government undertaking or in private organization any where in India. Also willing to be sponsored for advanced studies on long term service contract basis. (Office ref. E.S. 280)

ASSISTANT ENGINEER (CIVIL) in a Central Government department, 30 years, holding diploma in Civil Engineering from University of Roorkee; experienced in design and construction of road pavements, design of bridges and store holding; also Office experience in preparation of estimates dealing with tender documents, budgetary control, etc. Total experience over 7 years out of which four years in present capacity; seeks a responsible job in Government, semi-Government or private concern of repute. (Office ref E.S. 281)

MECHANICAL ENGINEER, L.M.E., passed diploma in Mechanical Engineering and Sections A and B of A.M.I.E. (India) in Mechanical Engineering subjects; having 7½ years experience in erection, operation and maintenance of boilers (high, medium and low pressures) compressors, pumps, evaporators and water treatment plants, 4½ years of service in power station boilers and its auxiliary units, and 3 years in utility services in-charge for steam water fuel oil compressed air and caustic soda. Present salary Rs. 550 per month approximately; seeks immediate change in South India in private or Government undertakings. (Office ref. E.S. 282)

YOUNG, ENERGETIC AND INTELLIGENT MECHANICAL ENGINEER, passed Sections A and B (Mechanical Engineering) of A.M.I.E. (India) with Production Technology and Automobile Engineering as optional subjects, aged 23 years, having experience of two years in machineshop maintenance as a graduate apprentice in two reputed private firms; seeks a suitable job in any of the reputed private organisations or semi-Government or in Government organisations anywhere in India, and is interested to undergo in advanced training either in India or outside with or without service contract. (Office ref. E.S. 283)

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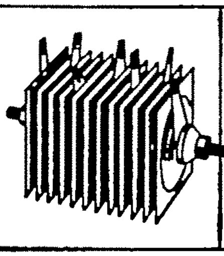

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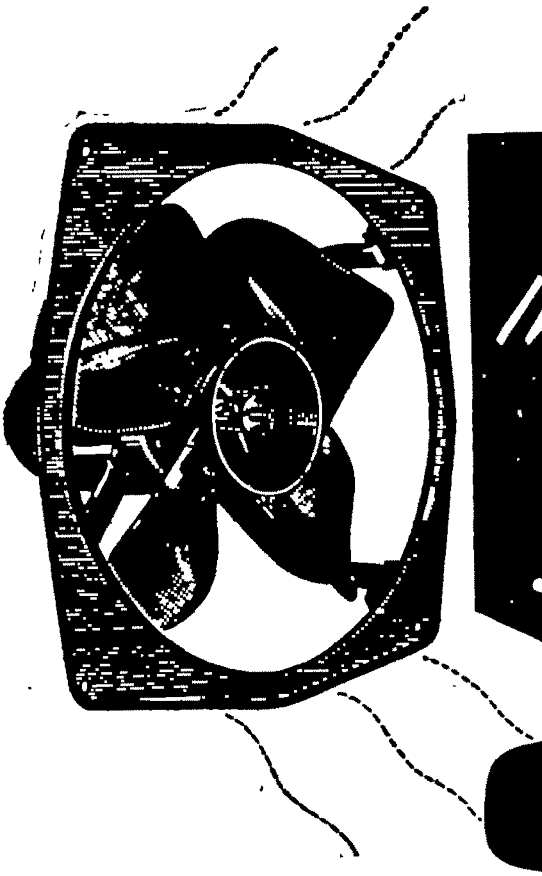

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The advent of glass fibre production in India makes possible an indigenous highly sophisticated design material with the essential qualities of damage resistance and extreme strength added. Fibreglass reinforced plastics has a wide range of unique qualities. Resistance to a wide range of chemicals, to the effect of weathering and general wear provides a material ideal for chemical plant, for road vehicles, for building materials and for any other application under the tough climatic conditions of this country, where long life and low maintenance are of prime importance. Complex shapes and double curvature are easily achieved economically. Simple moulding processes allow large one-piece mouldings to be made with low tooling costs. Higher strength/weight ratio than either steel or aluminium allows great reduction in weight. Replacement by fibreglass reinforced plastics of a steel component can show, strength for strength, a weight saving of upto 60%. Boat hulls upto 150 ft. in length, and rocket motor cases, missile nose cones, racing cars, road tankers up to 25,000 gallon capacity, rail tankers up to 40,000 gallon capacity have been made from fibreglass reinforced plastics. All sorts of building materials from decorative cladding, translucent sheeting and domes to moulds for concrete, street lighting columns and piping can also be made.

Fibreglass reinforced plastics offer the designer an initial freedom of approach and a subsequent flexibility, both of which are impossible to achieve with metal on economic grounds. Conversely, of course, any unit to be produced in fibreglass reinforced plastics should be designed to suit the material. The best results cannot be expected by copying a design based on the properties of conventional materials where the main concern is the availability of material in flat sheets which then have to be formed into shape. Right from the start, advantage should be taken of the mouldability of fibreglass reinforced plastics to produce the largest units possible, because once the mould is made, the effort required to produce complex shapes is little more than that necessary to mould flat sheets. The other outstanding characteristic offered by fibreglass reinforced plastics from a designer's point of view is the ability to carry out modifications during a production run, a relatively easy procedure when mould modification is the only consideration, but again impossible where the high tooling costs involved in metal construction are concerned.

Fibreglass reinforced plastics is in general use the world over, the growth pattern in Europe and America after its development 25 years ago being nothing short of revolutionary. In India, where climatic conditions are exacting and conventional materials such as stainless steel have to be imported, fibreglass reinforced plastics, which are not only indigenous but also eminently suited to Indian conditions, will encounter a growth pattern similar and perhaps more spectacular than that already achieved in America and Europe.

INDUSTRIAL PROJECT EVALUATION AND IMPLEMENTATION

K. F. Antia

Council Member and Past Chairman, Bombay

Introduction

1. The establishment of an industrial project on a sound basis entails detailed investigation and evaluation of the scheme, securing of necessary funds, engineering and construction of the unit, economic production of the goods, equipment or services envisaged and successful marketing of the products.

Industrial project evaluation entails collection and collation of data followed by an analysis which enables economic advantages and disadvantages to be assessed in the manufacture of specific goods or equipment or of services. It provides a rational basis for determining whether an enterprise is worth undertaking.

2. In countries such as India, where phased development is planned, project preparation is the link between planning and execution. Project evaluation involves a study of both technical and economical aspects of what originally may be vague idea. Such investigations enable proposals to be crystalized and the soundness of a scheme to be determined.

3. The first step is to ascertain whether a potential market exists for the proposed commodity. A rough assessment may be made by determining the extent of unsatisfied demand, the magnitude of imports, the extent of domestic production, existing exports and further possibilities of export. If the results of these preliminary study are encouraging, further investigations in the form of a feasibility study are justified.

4. The feasibility study may be broadly divided into .1 technical feasibility which is based on technical requirements and .2 economic feasibility and financial requirements.

Feasibility studies determine the commercial profitability of a project to the entrepreneur and also establish the economic profitability to the Nation. The most satisfactory method of obtaining reliable feasibility studies is to entrust these to competent consultants who, in the light of their experience, are likely to provide an exhaustive analysis and a sound evaluation of the technical and economic aspects, and of the profitability of the project.

5. When satisfactory profitability of a project is established, the following steps are required to be taken:

.1 Registration or incorporation of the company in accordance with the Companies Act of 1956,

.2 Procurement of various Government sanctions and licences such as the Industrial License in accordance with the Industries Development and Regulations Act of 1951, Import Licenses based on satisfactory arrangements of external finances either with private foreign companies or through foreign government credits or Banks,

.3 Exploration of the possibilities of financing the project. Various sources exist and success is achieved by approaching sources which are appropriate to the type of project envisaged and arranging the fulfilment of the requirements and stipulations of the selected sources. Possible sources are equity capital from the public and loans from banks and other establishments.

Where foreign know-how and equipment are concerned, loans covering the foreign component of the project may be obtained from .1 Private foreign sources, .2 The Industrial Credit and Investment Corporation of India, .3 The International Finance Corporation, .4 The Commonwealth Development Finance Company Limited, .5 The World Bank, .6 The Export-Import Bank of U.S.A. or .7 Other U.S. Government lending establishments. The latest addition is the Asian Development Bank.

6. In order to obtain equity capital, an effective presentation has to be made of the project in the form of a prospectus. The material in the prospectus has to be convincing, the presentation well balanced and the approach realistic if it is to induce financiers to give it consideration. An effective presentation is also required for obtaining loans from various sources. Some loaning authorities obtain relevant information through specific questionnaires.

The following aspects need to be included in the report to the loaning authorities

.1 Summary of the report, .2 Project history and some information regarding the promoters, .3 Engineering aspects of the project, .4 Commercial and economic aspects, .5 Effect of the project on the national economy and .6 Financial aspects of the project.

7. The Financing authorities carry out a detailed appraisal of the project to ensure that the technical investigations and deductions are thorough and satisfactory, that the commercial and economic considerations are adequate, that the estimate of cost is realistic and that the financial considerations are sound. The effect of the project on national economy is also taken into consideration in the final appraisal.

8. The excution or engineering of the project entails

.1 The preparation of designs and specifications for plant and equipment, for structures and buildings to house the machinery, and for various essential services such as power, water, transport, disposal of wastes, etc.

2 The preparation of a construction schedule in which the construction of all items of work are synchronized and dated

3 The preparation and issue of tender documents including detailed specifications and conditions, the analysis of tenders and the placement of orders

4 The supervision of construction and progressing of the work in accordance with the schedule

5 The measurement and valuation of the work done, followed by checking and certification of bills

.6 The commissioning of the various items of machinery and equipment and the realization of performance guarantees of machinery and equipment manufacturers.

Technical feasibility

1. In conducting a technical feasibility study, the technical requirements of the scheme have initially to be ascertained. These requirements may be grouped under

.1 The quantity, quality and accessibility of raw, processing and other materials for an industrial plant of a proposed capacity

.2 The type and quantum of various services necessary for such a plant, such as fuel, power, water and transportation

.3 The availability of suitable land at an economically advantageous location

.4 The availability of technical and other man power and of facilities for housing, training, etc.

2. Reliable data need to be collected on the quality and availability of the various requirements of the plant. The evaluation of costs for the various materials and services has to be done carefully as this has a crucial bearing on the production cost. Considerable field work is entailed in this investigation.

3. The approximate location of the proposed plant has a considerable bearing on the technical requirements and the determination of the location is one of the important factors in the success of a project. A detailed comparison of the facilities available at various locations, their proximity to raw and processing materials and to the markets for the products, and their accessibility by varous modes of transport, has to be made in determining the most satisfactory location.

Two important criteria in comparing the relative merits of various locations for a plant are

.1 Raw materials assembly cost and

.2 Finished products distribution cost

The raw materials assembly cost is the total cost at which various raw materials would be available at the proposed site of a plant. The costs are governed specifically by the cost of transportation to the site. Similarly the finished products distribution cost is the cost of the manufactured product at the various consuming markets and is again governed by the cost of transport. If the quantity of finished product is a fraction of the quantities of raw materials required for its manufacture, the raw materials assembly cost will be the lowest if the plant is located as close to the source of raw materials as possible.

4. Another important item of the study is the determination of the optimum size of the plant. The relative production cost in a small plant may be higher than that in a large plant and this may be due to higher overhead costs, comparatively high capital cost or lower efficiency of a smaller unit. The 'economy of scale' based on reduced overheads per unit of production has to be given consideration in determining the optimum size.

The production cost of the goods, machinery or equipment for different capacities of the plant have to be estimated and three types of production cost items have to be given consideration, namely

.1 Items such as depreciation which depend directly on the capital cost

.2 Items of overhead charges, including cost of effecting sales, accounting, and management of the plant, which are not appreciably affected by the extent of the output and

.3 Items of costs which vary directly with the quantum of production.

5. After collecting the data, selecting the best location and determining the optimum size of the plant, a technical feasibility report is prepared. Such a report needs to be supplemented not only with a number of appendices supporting the data and the deductions in the report but also with details of technical investigations on any controlling factors.

Economic feasibility

1. The economic feasibility study may be initiated by making a market survey to ascertain the extent of the market for the product, possibilities of expansion, the percentage of the demand which the proposed product can command and to ensure that production does not exceed the demand.

In carrying out the market study, existing production in the country is determined, import statistics obtained, possibilities of exports investigated and market for substitute products considered. The market figures should cover a period of about 10 years and projection for future trends should also be made for a similar period.

In making the projection, the rate of growth of the market may be based on economic trends in the country and comparison with other countries similarly placed, development in fields affecting the product may be considered and the possibilities of new fields ascertained. Substantial and steady increase in demand as well as in imports of the product are encouraging indications. Prospects in foreign markets need also to be considered. Export advantage will be present if the production cost is lower than that in other countries and the incidence of transport is less than in other exporting countries due to shorter distance or better transport facilities. Import restrictions, tariffs, etc., in the importing country are likely to be inhibiting factors.

2. The extent of the market likely to be covered by the new project will depend primarily on the production cost. A new venture should have a production cost advantage over existing units because of the latest know-how, up-to-date equipment and possibly economy of size.

3. The most important requirement in an economic feasibility study is the assessment of profitability of the project. In order to determine profitability, it is necessary to estimate the capital cost, the operating cost and the proceeds from sales. An estimate of earnings is obtained from the sales proceeds and the operating costs.

4. The initial estimate to be prepared is that of capital cost and considerable care and judgment are necessary to see that it is realistic and to ensure that the final cost does not substantially exceed the estimate. The capital cost estimate may be prepared advantageously under a number of

major heads and it is expedient to provide costs under separate columns for local and for foreign expenditures. Suitable major heads are .1 Site development, .2 Plant structures, .3 Machinery and equipment including freight and port dues, .4 Services *e.g.* power, water, transport etc, .5 Ancillary buildings, .6 Spare parts of machinery and equipment, .7 Import duty and other levies such as sales tax, octroi, etc., .8 Pre-operation expenses including planning, technical and economical studies, incorporation of the company and establishment of credit, .9 Training of special operating staff, .10 Consulting service, .11 Working capital and .12 Unforseen items which are taken as a percentage of the total cost. If any interest has to be paid on loans before the start of production, this has also to be charged to the capital estimate.

Working capital is required to cover the cost of raw materials and cost of labour during production as well as the period before realization of sale proceeds. Adequate provision has to be made for working capital and an approximate figure for this provision is three months cash operating costs.

5. As already indicated, in order to determine the profitability of a project, it is necessary to prepare an estimate of the operating cost. An operating cost estimate is based on the cost of .1 Raw, processing and other materials, .2 Items other than materials including operating labour, supervising and administrative staff, services such as power, water, lubricants and other consumables, .3 Overhead charges including depreciation, servicing of loans and amortization of advance expenditure, .4 Levies such as excise duty, .5 Unforeseen expenses for which a small percentage provision should be made.

The difference between the sales proceeds and operating costs provides an estimate of earnings which are required for repayment of loans, for building up reserves, for expansion, for payment of taxes and finally for payment of dividends.

6. In addition, an estimate of the cash flow is necessary to ensure that requisite funds are available when required. Cash flow estimates are prepared on a yearly basis and the extent and time of cash requirements are based on purchase orders for equipment and on the construction schedule. The availability of cash is from equity capital and loan. After the plant comes into operation, additional sources for cash are profits, depreciation accruals and short term credits

Financing the project

1. The technical and economic feasibility of a project having been satisfactorily established, the method of financing the project needs careful consideration. The various sources of finance have already been indicated. The proportion between loan and equity capital should preferably be 1 to 1 and not exceed 2 to 1. This is desirable to prevent heavy outgoing on loans which affects adversely the profitability of the project. Moreover if the contribution of the promoters is about one-half of the total equity capital, the raising of the remaining finance is made less difficult as the sponsors' contribution indicates their confidence in the venture which makes the loaning agencies favourably inclined.

2. Arrangements should be made to have the shares offered to the public underwritten by banks and investment groups. Underwriters buy a certain number of shares and resell in due course to the public whilst the promoters obtain without delay the necessary amounts to build up the capital. A certain proportion of shares are in the form of preference shares which ensure a fixed rate of return before payment of dividends to holders of ordinary shares.

3. Loans are negotiated with or are guaranteed by commercial banks, development banks such as the Industrial Development Bank of India, Life Insurance Corporation of India and other institutions such as the Industrial Credit and Investment Corporation of India. Bonds when made convertible to shares are more attractive as such convertible bonds combine the safety of bonds in the formative stages of the project with the advantage of a possible increase in the value of a well conceived project.

4. In case where foreign know-how and equipment are involved, equity participation by foreign suppliers of know-how or equipment is conducive to success of the project as they have a stake in the success of the venture. A number of foreign financing organisations have already been indicated. The International Finance Corporation, Washington, is an affiliate of the World Bank and participates in equity capital of industrial enterprises in the private sector only and without a government guarantee. The International Bank for Reconstruction and Development at Washington, also known as the World Bank, finances the foreign exchange component, through loans only, in any currency. Small and medium size loans from the World Bank are obtained through industrial development banks of the country and large loans are negotiated through the Government. The Export-Import Bank, also at Washington, advances loans, preferably to private enterprise, for purchase of American know-how and equipment but only when backed by guarantees from commercial or state banks of the country. There are in addition a number of other lending sources in the U.S.A. such as the Agency for International Development. The Asian Development Bank, recently formed with headquarters at Manila, is to finance projects through loans on basis similar to that of the World Bank.

Design and engineering of the project

1. When a project is found to be economically and technically feasible and ways and means have been determined for financing it, the design and engineering of the project is the final step for implementation. A rational method of carrying out design and engineering efficiently is to entrust the work to consulting engineers as they have the requisite know-how and experience for implementing the numerous requirements satisfactorily.

2. The location of the plant having been selected, site preparation including levelling of the area is undertaken and soil investigations are carried out to determine the loads that can be placed on the foundation. The layout of the plant is prepared with machinery and equipment so located as to produce the most efficient movement of materials under process and incorporating the various services such as power, water, gas, compressed air, lubricants, etc.

3. Simultaneously specifications are prepared for the various items of machinery and equipment and also for all civil and structural engineering work.

4. Details of various essential services, namely, power, water, transport etc. are worked out. Power may be either generated at plant or more likely obtained from the state electric grid. A complete power distribution system is designed. Similarly an entire water supply system is designed including both collection and distribution. Transport of raw materials and finished products to and from the plant may entail railway tracks, roads and ropeways. Material handling within the plant may be arranged with belt conveyors, overhead electric cranes and various types of mobile units and also by rail transport.

5. Detailed designs of plant structures and ancillary buildings are prepared together with those of other non-process engineering works.

6. A programme of construction is set up in the form of construction schedules in which site investigation and site preparation, fabrication and erection of structures and buildings, together with their foundations, procurement and installation of machinery and equipment, and of all services are synchronized.

7. This is followed by the preparation and issue of tender documents for the procurement of machinery and equipment and for the construction of all civil, structural, mechanical and electrical work. The tender documents cover the general and special conditions of contract, detailed specifications of the equipment or work envisaged and a schedule of quantities. The quotations received from tenderers are analysed and contracts are awarded on the basis of the analysis.

8. The field work is undertaken by contractors on the results of tenders and field supervision of the work by the consultants entails a constant check to ensure that the work is carried out in accordance with the specified terms and conditions, that it is of a quality commensurate with the specifications and that the progress is in accordance with the construction schedule. A quantity survey of the work has to be carried out and bills checked for payment.

9. The erection of machinery and equipment is usually done by the suppliers and output in accordance with performance guarantees has to be ensured by them.

10. Whilst construction of the plant is in progress, training of the key staff is arranged and recruitment of other staff is so phased that the plant is adequately manned when it is ready to go into production. The subsequent performance of the plant lies in the hands of the management.

CORRIGENDUM

TO VOL. 16, NO. 7, MARCH 1967

Page 58, under 'Membership Promotion in the Institution', please read the second sentence as 'Measured in numbers, the total membership has moved up from 15,904 in 1956 to 55,447 in 1966.'

HISTORY OF BHARATIYA TECHNOLOGY

J. G. Bodhe

Member

The Council Meeting at Ootacamund on April 30, 1966, considered the desirability of compiling a concise but comprehensive history of Engineering and Technology in ancient India from Vedic times to the advent of British Raj. At their next meeting at Bombay, on August 7, 1966, the Council requested Shri Bodhe to examine the scope of the work, and submit a preliminary note on the subject Shri Bodhe has accordingly perused a considerable amount of available literature written by several renowned authors in India and abroad, in English and other languages; and he has consulted persons with long acquaintance and keen devotion to the subject. The following report is the result:

1. References to Technology (which work in this note will include engineering) could easily be traced to Vedic literature. A number of books are available in Sanskrit describing numerous aspects of engineering and technology, inclusive of aviation, chemical engineering, electricity, atomic physics, etc.; but they have remained unexplored by modern Indian engineers due to the language barrier.

2. The earliest known concrete evidence of engineering achievements could be found in excavations at Mohanjo-Daro, which have exposed planned water-supply and sewage systems forming part of a systematic town-planning. Ancient treatises are not available in this connection; but archaeological reports in that connection will serve some purpose.

3. Technical literature as such, apart from Vedic and Pauranic references to civilized life and mechanical contrivances, is not available at present for any period prior to 500 B.C. Buddhistic literature spreading over 500 B.C. to 500 A.D. is, however, full of positive descriptions of technological progress. The *Jatak* stories contain substantial evidences of material prosperity and advancement. Even Sanskrit literature of classical authors like Kalidas bear testimony to the same conclusions.

4. In the region of Emperor Ashok, industry and commerce were at their zenith right from Kabul and Kandahar to Bangkok and Bali. Road communications and shipping facilities connected prosperous cities like Pataliputra, Ayodhya, Kaushambi, Takshashila, Dwarka, Kanjeevaram, and the like, spread over the entire length and breadth of the country. Several monuments of that age would yield concrete evidence of technological theory and practice current in those days.

5. Archaeological monuments from 500 A.D. to 1500 A.D. also exhibit a high pitch of skill and excellence, of design as well as of structural technique. The Ellora Caves, including amongst them the Kailasnath Temple stand superb as monuments of skill and patience. The Ajanta paintings which have wonderfully withstood the effects of weather and age, can stimulate even today the imagination of paint manufacturers.

6. Buddhist *Stupas* like Sanchi, and South Indian temples like Tanjore, Srirangam, Chidambaram, Halebid--all tell the same story of scientific knowledge and artistic presentation, irrespective of the colour or creed of the architects and the artisans. Apart from these dumb monuments, vocal descriptions forming part of travel accounts of European, Arabic and Chinese visitors, century by century, give a graphic image of prosperity seen by them all over India—the land classically famous as 'flowing with milk and honey'. Such an all round prosperity is impossible without an advanced technology.

7. Then come the Vijayanagar, and Moghal-Mahratta periods. Vasco-da-Gama certifies the superiority of Indian shipping and navigation facilities over contemporary European counterparts. Dutch, French, Portugese, and finally the British trading companies thrived for three centuries on precious goods manufactured in India by Indians. Indian currency carried a high status, an English pound fetching only eight or ten rupees, as against fifteen, thirteen or twenty-one rupees after late nineteenth century. Historical records of these periods are plentiful in several Indian and European languages; and it would be necessary to collect independently, all authentic information available from these widespread sources. Communications, canals, reservoirs, guns, fortifications, agriculture, medicine, finer arts and entertainments—all will yield splendid facts for pride and emulation. The Taj Mahal, Gol Gumbaz, Kutab Minar, Agra Fort, will form specific chapters.

8. Bibliography in comprehensive form will be too big for this brief note—but even so, the following few deserve here a specific mention:

(i) Kautilya's *Arthashastra*—A masterly treatise on economics and politics, which also deals with military science and town planning with several other topics including irrigation and agriculture

(ii) Bhaskar-Acharya's *Siddhanta-Shiromani*—A comprehensive treatise on mathematics and astronomy, inclusive of mensuration, trignometry, and instruments. It has been demonstrated recently that super-modern tables for micro-trignometry can be based on easier and simpler formulae introduced in this book.

(iii) Varaha-Mihir's *Brihat-Samhita*—A laudable compendium on several arts and science, inclusive of water-devining.

(iv) Bharadwaja's *Vimana-Shastra*—A detailed treatise on aeronautical subjects and flying machines, heavier than air, run by electrical and solar energies. Even discarding such an ambitious treatise is not possible without a close and intelligent study.

Generalising all such literature available to him, Prof. Max Muller wrote:

> 'Recent Indologists have demonstrated that India was the unquestionable cradle not only of 'primitive' arts and science, but even of very advanced versions of the same—often excelling modern progress up-to-date'.

9. From the above brief survey it will be seen that technology has had a great past in India. Some records are easily available and generally known; others may have to be searched and studied. Such efforts by our Institution

will bring forth many unknown things; and they would stimulate independent thought and creative potential in generations to come. The compilation of a history of this Bharatiya Technology even in the form of an outline needs deep study, scholarly comprehension, practical wisdom, and prolonged application.

10. The Council might, therefore, constitute a small *ad-hoc* Committee to pursue this investigation, and authorise it to entrust the work to suitable persons and incur the requisite expenditure. This Committee might also find ways and means to publicise and popularise the available information, while it is busy seeking new information and explanation of known facts and events. Our Institution has already established a Museum of Ancient Indian Technological Literature at Nagpur; staff is now necessary to collect all other printed source material, and a considerable part of the manuscript materials; and also to collate that material in convenient form and convinsing words, so as to present an attractive and enlivening volume of Bharatiya Technological History.

At the Fifth Meeting of the Convenors of Panels held at Jaipur in December 1966 the outlines with regard to the problem of compilation of 'History of Ancient Indian Technology' was presented by Shri J. G. Bodhe *(M.)*. It was resolved that a sub-committee consisting of Shri J. G. Bodhe as Convenor and Shri R. N. Joshi *(M.)* should be formed and they might select a few more members.

The present sub-committee consists of Shri J. G. Bodhe (Convenor), Shri R. N. Joshi, Major N. B Gadre *(M.)*, Shri D. P. Jog *(M.)* and Shri G. K. Agrawal *(M.)*.

The meeting also recommended a grant of Rs. 1,000 to be paid to Shri Bodhe for compiling a preliminary report on the proposed project of compiling the 'History of Ancient Indian Technology'. This has been sanctioned by the Council.

At the Closing Session of the 47th Annual Convention, Shri J. G. Bodhe made an appeal to members requesting their help in the compilation of the history of ancient Indian technology.

Members are therefore requested to furnish any information or reference available with them to Shri J. G. Bodhe, M.I.E., Consulting Engineer, 24/28 Dalal Street, Fort, Bombay 1.

INSTRUMENT SERVICING AT THE NATIONAL PHYSICAL LABORATORY

The National Physical Laboratory (NPL), New Delhi, now services its own instruments, saving valuable time and money in the process. It also offers its spare capacity in this respect to other educational, industrial, medical, etc., public and semi-public institutions, on payment basis.

That there exists a very pressing need for such a service by other users of instruments is borne out by the fact that the NPL has been receiving instruments for servicing, modifications or calibration from places as far apart as Calcutta in the east, Ladakh in the north, Bombay in the west and Vijayawada in the south and a host of other places in between. By now it is a nationally-known service. Since the work is restricted to portable instruments which can be sent here accompanied by a person, most of the external work has come from nearby Punjab, Rajasthan, Uttar Pradesh and Delhi itself.

The NPL has averaged the servicing of instruments worth two lakhs of rupees every year and 9% of the instruments set right are the imported ones. The figure of the actual cost price of the equipment is given here because in majority of the cases, servicing of these instruments meant the release of foreign exchange invested in them which was lying blocked besides restoring the usefulness of the apparatus which was originally the basis of its purchase. Again, on an average, the NPL has put back into service 75% of all instruments received by it, inspite of the difficulties of non-availability of exact spares which would have required imports or specialized test equipment. What stands them in good stead is the variety of available facilities some of which are unique—a top-ranking glass blowing shop, a fine machine shop, calibration and ancillary facilities, an excellent technical library, in short the position, location and the outlook of NPL.

This type of service is not offered commercially in any large measure because of the high degree of diagnostic skills required, expensive test equipment, lack of imported spares, the time required to understand, analyse and do the work on a wide range of instruments each one of which may be a speciality itself—factors which make this work uneconomic in nature for commercial interests, even more so because of the insufficient volume of any particular type and therefore the in-applicability of assembly-line or the trouble-locating chart methods. In this context, the servicing of cars or radios is economic, because these are manufactured here, the parts are available and the same types of cars or radios are there in large numbers.

A hospital 'services' human being, if we may compare, whose anatomy is the same in every case. The medical profession distributes the treatment of the human body which comes in just two models—male and female—over a number of departments, *e.g.*, ear, nose, throat, skin, cardiac, neurology, etc. The human body is self-healing in many cases even if a mistake is made in the treatment. But the NPL has to take all varieties of instruments in its stride—each one of which may have a different set up inside as made by different makers, and each is a job to be learnt as understood before it can be attempted and where a mistake made at the wrong place may be irretrievable and then we cannot get away by calling it an act of nature if 'the operation is successful but the patient dies'.

Just as a qualified doctor only is allowed to handle a patient for diagnosis while the treatment can be given by a compounder or a nurse, similarly it is necessary to have engineer-level persons of proven competence to do the diagnosis while the replacements, etc., can be done by technicians. The main difference is that instruments are inanimate and man-made, compared to the humans. It has been experience of the NPL that if the repair of an expensive or intricate instrument is attempted by an unqualified, untrained or a careless person, irrepairable damage may be caused to the equipment. Also in contrast to the availability of medicines for the doctor, specific medicines for specific diseases, the NPL has to end up by writing its own prescriptions, making the medicine and administering it

To give some examples of the nature of work, it may be listed below some actual instances of both conventional and esoteric instruments such as multimeters, pH meters, ophthalmoscopes, photo-electric calorimeters, binocular microscopes, oscilloscopes, eye-operation machines, cautory, diathermy, temperature controllers, valve analysers, single-pan micro balances, flame and spectrophotometers, polarographs, photostat machines, artificial respirators, nerve stimulators, fundus cameras, hypodermic needle cleaning machines, electronic anaesthesia, blood oxygen and blood count analysers, ultrasonic flaw detectors, gas analysers, glaucoma testing machines, electronic electrometers, high speed counters, etc., and we are willing to attempt other new jobs, provided the customer—in all cases, the actual user—accepts our terms for doing the work.

The NPL has had as its clients for this work, institutions doing research or other work in the disciplines of physics, chemistry, agriculture, medicine,. dairy, public health, veterinary science, biochemistry, irrigation, to name a few. Work also came from the national laboratories of the Council of Scientific and Industrial Research, defence institutions, the local hospitals, medical institutions, the universities, public utilities, central ministries, education and technical institutions.

Advisory services

The complexities of designs and the availability of a multitude of equipment performing the same functions, makes it imperative that their proper use is understood by the user. Keeping this in view, the NPL also offers to explain the proper use of new equipment to the users, and, of course, every serviced job goes back after a demonstration of its correct method of use.

In the process of servicing a wide range of scientific laboratory type instruments and equipment over the past few years, a sizeable amount of data on the performance of a number of instruments is available. Certain of these can be classed only as 'budget-finishing'. This applies to both indigenous and imported ones. Also in course of this work, a directory of spares and mechanisms which are now available in India has also been compiled. Consultations in either the purchase of new equipment or availability of spares-buyers guide type of information is offered free to a host of inquirers from all over the country. The views of the NPL on the defects in a number of types of instruments have been published in an article, '150 Instrument Servicing Jobs—an Analysis' in the *IMDA Journal* (November 1965).

Also, as a department which is in constant contact with both the users and the instruments, the NPL is in a position to convey to the manufacturers the difficulties of the users concerning the notice, for suitable remedial action—a sort of feed back which is so essential for the development of better instruments.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Gujarat Centre

Chairman's address by Shri Nandubhai K. Patel, B.E. (Civil), M.I.E., at the 7th Annual General Meeting of the Centre on January 8, 1967

After welcoming the Chief Guest, Prof. N. S. Govinda Rao, and other invitees, Shri Patel thanked the Committee of the Centre for electing him Chairman for the ensuing year.*

Delivering the Chairman's address, Shri Patel said, 'It is rather customary and appropriate also that on an occasion like this, I deal with a subject with which I am so itimately connected for a long and valuable period of my life. The subject is Irrigation in India in the context of the country's food crisis with special reference to Gujarat. The subject may also be found of general and current interest to every Indian in view of the serious difficulty that we are facing about food. The subject is projected to a sharp focus recently when many parts of the country are facing serious drought conditions and people in these areas are threatened with starvation and death. The world itself is facing general food shortage in view of its growing population. The United States of America which was our chief source of import of food so far is now showing callous disregard for our food needs at a time when human considerations dictate otherwise. It has become increasingly difficult to get food from abroad without subjecting ourselves to political pressures affecting our national policies. As a self-respecting nation, therefore, it is time that leaving aside everything, except defence, we wage a total war on this front of food. To us in Gujarat, the question is even more vital as our State is awfully deficient in production of foodgrains. If we ponder and analyse causes of many of our present evils and difficulties, we shall come to one inevitable conclusion that the shortage of food in the country is the basic evil and that there is no way out but to achieve self-sufficiency in food production as early as possible. In the background of the present political atmosphere in the country and narrow and regional outlooks of some of our States surplus in food resulting in continuation of food zones, we in Gujarat can remain complacent in this matter at great peril.

During the last World War, we were rudely shaken to realise a fact that our country, where about 75% of our population live on agriculture, was not producing enough food to feed millions of its hungry and half-starved citizens After the advent of independence, therefore, great emphasis was naturally laid on Irrigation by the Planning Commission who gave great importance to irrigation schemes in formulating various Five-Year Plans. A target was fixed to increase the area under irrigation by 100% in 15 to 20 years. In the beginning of the post-independence period, weir and canal schemes were proposed and undertaken all over the country with a view to creating irrigation potential as quickly and as extensively as possible. In the First Five-Year Plan, irrigation schemes were pushed on with almost war-like fervour. In the mid-fiftees, the late Pandit Nehru declared that the country should stop imports of food within two to three years. However, though we carried forward irrigation schemes in the Second Plan, emphasis on their speedy implementation was progressively reduced and industrialisation was given equal importance. In the Third Plan there was further diversification of objectives. The result was that instead of stopping imports of food grains, the rate of food imports has been progressively increasing from the end of the Second Plan to the present day. Even acknowledging the fact that the last two monsoons were unfavourable, it is clear that the country has been increasingly depending on foreign countries for food imports

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* The photograph of Shri N. K. Patel was not received till printing.

During the Pakistani attack, we were threatened with stoppage of wheat supplies from America. It was then that some deficit States took the challenge and resolved to become self-sufficient in food in two to three years. The country itself set a target of achieving self-sufficiency in food in about five years. The late Shri Lal Bahadur Shastriji gave his famous slogan '*Jai Jawan Jai Kisan*'. Since then the country has been witnessing all-round feverish activities to increase food production rapidly. The highest priority has been given to agriculture in the Fourth Plan that we have prepared. Approximately one-third of the total provision of the Plan has been allocated to agricultural, irrigation and power sectors. Even in the power sector, rural electrification has been given priority so as to increase area under lift irrigation.

As it is well-known, the total food deficit in the country is marginal, say about 7 to 8%. However, this percentage of deficit has remained more or less constant during all these years. Food production has increased by 65% in 14 years due to implementation of the Five-Year Plans. But this substantial increase in food production has been greatly negatived by a great rise in population. It is, therefore, necessary that we should step up food production at a much faster rate than the present rate so that self-sufficiency in food is achieved on a long-term basis even after taking into account probable demands due to reasonable rise in population and better standards of dieting habits. This is quite feasible by applying scientific methods. True, there is a limit to increase the area under plough, but yields of crops per acre can be increased substantially. As compared to other advanced countries who have stepped up their food production by advanced methods of scientific farming, crop yields in the country are low, say, one-third or one-fourth on an average of those in these advanced countries. More fertilisers, and better seeds give certainly much better yields. But all this scientific approach to the problem would lead us to one conclusion that proper quantity of water to crops at proper intervals is the pre-requisite. Thus, irrigation is the basic input out of other inputs for more agricultural production.

India lies partly in tropical and partly in sub-tropical regions and has extreme climates in many parts. Except for small areas, rainfall is concentrated in the four months of monsoon, say, June to September. The remaining period of year is practically dry. Though total average rainfall in many parts of the country is 25in. and above, *i.e.*, favourable, the characteristics of the rainfall are its unequal distribution during the season as well as its great variation from year to year. Therefore, successful cultivation is not possible in large parts of the country without the aid of irrigation. Depending on rainfall alone, large areas in the country can produce but one crop in a year, though as indicated above temperature conditions would permit two or more crops over most of the country. Crops are very poor in the places where rainfall is deficient. Moreover, there are vast areas where no cultivation is possible, unless irrigation waters can be made available. Therefore, irrigation is necessary: (i) for stabilizing the monsoon cultivation in most parts of the country and averting conditions of famine and drought to a great extent; (ii) for increasing the area under cultivation in arid and semi-arid regions; (iii) for having two or more crops on the same land; and (iv) for increasing yields of crops per acre by changing crop pattern and by applying scientific methods, namely, more fertilizers, better seeds, etc.

What applies to India applies to Gujarat with a greater emphasis. Rainfall is about 25 to 30 in. in most of the area of the State, however its seasonal and yearly variations are more marked. About 90 to 95% of the rainfall is restricted to monsoon months. Rivers are comparatively flashy. On the other hand, there are fertile lands and enthusiastic and progressive agriculturists. It is an irony that many parts of the State are affected often by famine and drought conditions and average crop yields are now compared to other States of India.

The available water resources in the country have been estimated at about 1,360 million acre-ft. but owing to physiographical limitations about 450 million acre-ft. only can be used for irrigation. Up to 1951, only about 76 million acre-ft. or 17% of the usable annual flow were utilized. This increased by the end of the Third Plan to about 150 million acre-ft. or 33% of the usable flow. Another 50 million acre-ft. are likely to be added in the Fourth Plan. This will bring the total up to 200 million acre-ft. or about 45% of the usable flow.

The area which can be ultimately irrigated by major and medium irrigation schemes is about 112 million acres (gross). At the beginning of the First Plan in 1950-51, the gross area irrigated from all sources was about 56 million acres, of which 24 million acres were from major and medium schemes. With the creation of irrigation facilities for an additional area of 18 million acres from such schemes in the three Plans, the area left over for future development through major and medium schemes is about 70 million acres

The outlays for major and medium irrigation schemes in the successive Five-Year Plans are as follows:

		(In crores)
From 1800 to 1951	...	Rs. 100 (approx.)
First Plan	...	Rs. 300
Second Plan	...	Rs. 380
Third Plan	...	Rs. 572 (approx.)
Fourth Plan	...	Rs. 849

The long term potential for the development of minor irrigation has been estimated at about 75 million acres (gross), made up of 30 million acres from surface water and 45 million acres from groundwater resources. The actual level of development expected to be reached at the end of the Third Plan period was about 50 million acres. The target for minor irrigation in the Fourth Plan has been fixed at 17 million acres.

As far as Gujarat is concerned, total usable water resources are approximately estimated at about 54 million acre-ft., of which about 50% are planned to be utilized by irrigation and power schemes undertaken already or proposed to be undertaken in the four Plans. The following table indicates the Planwise development under Irrigation sector, i.e., major and medium irrigation schemes.

Plan period	Amount spent, Rs. in crores	Total irrigation at the end of each Plan period (in lakh acres)	
		Potential	Actual
First Plan (1951-56)	18.51	0.58	—
Second Plan (1956-61)	35.54	6.16	1.64
Third Plan (1961-66) (Anticipated)	44.26	12.15	4.09

In the Fourth Plan, on outlay of Rs. 90 crores is provided for medium and major schemes. The total cropped area in the State is about 241 lakh acres. Actual irrigation of about 26 lakh acres will be achieved at the end of the Third Plan as a result of minor irrigation schemes. Taking this into account the total area under irrigation would be about 30 lakh acres. Thus about 12.5% of cropped area in the State will be under irrigation at the end of the Third Plan period as compared to 27% for the whole of India. The State has, therefore, to go a long way in making the lee-way in irrigation development. Prior to independence, there were practically no big irrigation schemes and most of the area under irrigation was from surface wells. Total irrigation was about 5% against about 17% in the whole of India. The percentage increase in area under irrigation is more than double in the State during last 15 years which is comparatively better than such increase in India.

However, a peculiar feature of irrigation development in the State, is that figures of actual irrigation are much less than those of irrigation potential created. These figures show that actual irrigation is lagging far behind irrigation potential created. It would perhaps appear that we are not utilizing irrigation potential created properly, but the actual picture is not so dim. A bulk of our irrigation potential is under weir and canal schemes, *viz.*, Kakrapar and Mahi canals and therefore irrigation depends upon the actual run of the rivers at the end of irrigation seasons. Rivers being flashy, flows dwindle down considerably in October and further they are reduced almost to a trickle in fair season. Moreover, there is too much certainty of water supply on these schemes with the result that there is great handicap in developing irrigation. Storages on these rivers as a second phase of development are unnecessary but they are either under construction or at the start. The reason for this is peculiar political boundaries of the State. All big rivers are inter-State rivers. The sites of the reservoirs are situated in such a way that submergence areas lie in upper States. Another peculiar feature of irrigation in the State as compared to other States is that there is comparatively a large percentage of lift irrigation as compared to flow irrigation. It is about 3:1, *i.e.*, lift irrigation is in 75% of the total area under irrigation whereas flow irrigation is in about 25% area. This would also indicate that when cultivators take advantage of lift irrigation which is comparatively costly on such a large scale, there should not be any doubt that they would not avail of flow irrigation which is comparatively cheap and convenient.

As mentioned earlier the rate of increase in food production is required to be stepped up in the next five years. Therefore, greater emphasis is now required to be laid on minor irrigation in general and lift irrigation in particular. The Fourth Plan takes into account this aspect. But though minor irrigation schemes have an important place in short term planning, their reliability is limited. Therefore, for intensive agriculture and scientific farming, major and medium schemes are required and they have to be included in any long term planning. Lift irrigation schemes are most reliable in averting drought conditions and intensive farming but for their more lasting value and for proper recharge of their sources rain water is required to be conserved by surface schemes, *viz.*, tanks and *bandharas*, small or large. Gujarat particularly is a water deficient state and there is difficulty of even drinking water in many parts.

As mentioned above, the total irrigation potential created now is about 12.0 lakh acres as a result of medium and major schemes. After harnessing big rivers like Sabarmati, Mahi and Tapi and some small rivers, total irrigation potential that will be created will be about 25 lakh acres, say, at the end of the Fifth Plan. As against this, total irrigation potential by Narmada Project alone as per recommendations of the Khosla Committee's report, would be about 45.81 lakh acres. Moreover, the high level Narmada canal as envisaged in this Report passes through and commands very fertile lands. Additionally it would extend upto Rann of Kutch on the Pakistani border. This would enable us to reclaim that vast waste and convert it into a fertile region to rehabilitate sturdy ex-service men. This point need not be overemphasized from defence point of view. After this giant project is brought into commission, Gujarat will not remain a State backward in irrigation as total potential then would be about 70 lakh acres giving about 30% as area under irrigation to total cultivable area by major and medium schemes alone. It will also no longer remain a State deficit in food but will be able to spare a sizeable surplus to fellow countrymen. Importance of this Project from national point of view thus is evident and therefore on this occasion it would not be out of place if I reiterate the request for its very early implementation as a national project.

Lastly, I shall conclude with a few quotations:

Rishi Narada enquired of King Yudhisthira about the welfare of the State and asked: 'Are farmers sturdy and prosperous? Are dams full of water and big enough and distributed in different parts of the kingdom and does agriculture not depend upon rains alone?'

Manu says: 'A king who wishes to conquer his enemy should first of all destroy all dams in the territory.'

Akbar wrote in 1568, 'For God has said, from water all things are made.'

Land and water are two invaluable gifts of Nature to man. It is for him to conserve and utilize them for his survival with science and technology.

Jai Kishan Jai Vigyan.'

Kerala Centre

Chairman's address by Shri S. Rajaraman, B.E., M.I.E., at the Twentieth Annual General Meeting of the Centre on January 11, 1967

The Chairman welcomed the Chief Guest and other invitees and said, 'I deeply appreciate the honour the Committee of the Local Centre has done me by unanimously electing me as the Chairman of the Kerala Centre for this year. I feel all the more honoured, because when this Centre was born in 1947, it was nurtured by me as the first Honorary Secretary. This Centre with a total strength of about 40 at the time of its inception has grown up to the stature of 34 Members, 282 Associate Members, 29 Graduates and 760 Students on its Rolls at the commencement of the Institution year in September 1966.

1.2 As you all know, this Centre of the Institution has two Paper Centres at Quilon and Alwaye. The Quilon Centre, thanks to the keen interest taken by Sarvashri Hameed and Peer Mohammed, is playing a very active part and the new Alwaye Centre with the very large number of engineers in different fields of technology in the industrial complex of Cochin is sure to make useful contributions in the coming years. The Student Chapter at Trivandrum with a membership of nearly 900 continues to be active in studies, in holding technical discussions and in the athletic field. The Book Bank scheme initiated by the Institution has been very well received by the managements of the engineering colleges in the State. In 1965, the scheme was inaugurated in the engineering colleges at Trivandrum and Trichur, and in 1966, this was extended to the colleges at Quilon and Palghat. All the technical meetings are at present conducted under the joint auspices of the Association of Engineers, P.W.D., the Kerala State Electricity Board Engineers Association and the Association of Public Health Engineers.

1.3. The Paper Centre at Trichur, which was once very active due to the cooperation extended by the different engineering organizations in and around Trichur, will be reactivated. New Centres at Calicut and in the Idikki Project area, deserve consideration. I appeal to my brother engineers in these zones to make my vision come true. The Book scheme will be extended to the two remaining Engineering Colleges at Kothamangalam and Calicut. As there are at present over 300 candidates taking the Institution examinations, twice a year, much inconvenience and hardship is felt by many of them in being required to travel all the way from the Central and Northern zones of the State to Trivandrum. Active steps are being taken to open an examination centre in the Engineering College, Trichur, so that the students from the above areas as well as those from the adjoining areas of the Madras State can conveniently take the examinations at Trichur. Our activities in the fields of contribution of technical papers and holding seminars have not been as spectacular as in the past. But with the implementation of the Fourth Plan schemes which envisage major projects, I am sure my colleagues will find it possible to come forward and give the benefit of their experience by contributing more papers and taking part in the seminars. Excursions to engineering projects will also be arranged. Purchase of a film projector and public address system and an extension to the Institution building to provide for the accommodation necessitated by increased activities will be considered during the year. I can assure you that it will be my endeavour to follow the high traditions built up by eminent past Chairmen like Shri Kuttiammu.

It is customary on such occasions for the Chairman-elect to deal in a general way with engineering developments and then to refer in detail to the activities in his field. As we are at the moment concerned with the Fourth Plan proposals of Kerala and implementation of the recommendations of the Education Commission, I shall deal briefly with these topics

Fourth Plan of Kerala

2.1. The National Plan envisages an outlay of Rs. 16,000 crores in the Public Sector and Rs. 7,750 crores in the Private Sector for India as a whole The State Plan provides for an outlay of Rs. 283 crores with the possibilities of another Rs. 10 crores worth of centrally-sponsored schemes being transferred to the State sector. While the National Plan aims at raising the per capita income from Rs. 448 in 1964-65 (at 1964-65 prices) to Rs. 532 at the Fourth Plan, the State Plan is expected to raise it from Rs. 417 to Rs 461

2.2. The objectives of the State Plan are: (i) to maximise agricultural production, (stepping up production of foodgrains from 12 lakh tons to 21 lakh tons against 25 lakh tons required) particularly rice, by use of high-yielding variety of paddy such as Tainan-3, Taichung-Native 1, intensive cultivation and improved practices and to develop animal husbandry, poultry, etc., on modern lines; (ii) to develop fisheries, through mechanization and provision of ancillary facilities; (iii) to exploit the power potential to meet the anticipated demands (by stepping it up from 192.5 MW to 806.5 MW); (iv) to stabilize existing Government-owned industries, to provide for their expansion, wherever necessary, and to encourage small scale industries; (v) to maintain the same level of social services allowing for the normal requirements of population growth and giving priority to technical training and improvement in quality of education; and (vi) to undertake intensive Family Planning Programme so as to reduce birth rate from 4 to 2.5% per year.

2.3. The main programmes having a large bearing on the engineering profession are: Rs. 48.5 crores for irrigation and anti-sea erosion works—the important irrigation schemes being Kuttiadi, Chitturpuzha, Pampa, Pazhassy, Kanjirapuzha, and Kallada; Rs. 82.5 crores for power aiming at completion of at least one unit of Idikki project, construction of Edamalayar project more with a view to letting down adequate fresh water in the Periyar to prevent influx of salinity and protecting the industries in and around Alwaye, and provision of a thermal plant; Rs. 28.3 crores for industries in the State sector as explained under 2.2 above. In the Central sector, the main projects that will be taken up are: expansion of Hindustan Machine Tools at Kalamassery, the Precision Instruments Project at Palghat, Cochin Fertilizer Project, Cochin, FACT fourth stage, Alwaye, expansion of D.D.T. Factory, Alwaye, and Travancore Titanium Products, Trivandrum, second Shipyard at Cochin and Cochin Oil Refineries, Cochin.

Engineering

3.1. This can be done best by quoting from my article on 'Technical Education and Its Development (1966-81)' presented at the Seminar on 'Technical Education' held at the Lucknow Session of the Institution in 1965. 'Engineering is defined as the use of Science to fulfil the needs of man. When dams had to be put up, rivers bridged, cities built, and factories constructed in large numbers, civil engineers were needed. Now when machines are to be manufactured, automobiles and aircraft are to be produced and gigantic steel plants are to be brought into being—all in large numbers many mechanical engineers are required. The need for control and automation, the tremendously increasing communication problems, and the astounding scientific developments now call for more and more electrical engineers. Projecting a little further, one can predict a rise in the requirements of personnel with a good background of knowledge of physics and mathematics and even biological sciences. The rivers are being spanned but the problem is how to deal with water pollution. Cities and factories are being built but the problem is what to do about the slums and the foul air. Better ways of killing people are found but the problem is to find peace. What we need, therefore, is not so much scientific research, i.e., search for pure knowledge, but engineering research (answers to questions arising out of the needs of man), on (i) food—where improved methods of processing and storage and new means of manufacture are required; (ii) water—where new sources from the sea or the weather have to be developed and pollution of existing sources reduced; (iii) air—where pollution from industry and automobiles will have to be removed; (iv) waste disposal—which has tremendous engineering implications both for developed and developing nations; and (v) problems of communication and transportation.' All the above go to show that a correct appraisal of all these aspects is necessary for preparing a comprehensive, perspective plan of development. It is worth remembering in this context what our late Prime Minister, Shri Nehru, said 'The person who is important today is the engineer, the scientist and the technical man. The fact remains that the type of specialized work like that of the engineers or scientists is becoming more and more important. The future of the country will depend more and more on them rather than the administrators.'

Assessment of technical education by Ministry of Education

4.1. In a planned economy, the demand and supply of manpower are vital ingredients. Unless an adequate supply of the necessary trained personnel is ensured, the progress of development projects in any field suffers. In turn, unless the projects throw up a sufficient number of jobs to absorb the available manpower and provide employment opportunities in an increasing measure, the economic system becomes stagnant. Therefore a balance between demand and supply of manpower must be maintained at all times. This calls for an integrated and statistical approach to the problems.

In expanding technical education, at least a 10-year perspective of the development of the country should be considered. The Fourth and Fifth Plans will provide in full for the requirements of agriculture and consumer goods and a big step up in the investments in the metallurgical, fuel, chemical and machine building industries, the investment in the Fifth Plan being about Rs. 34,000 crores. Technical education will have to be expanded to produce 130,200 engineers and 260,400 technicians during 1971-76.

4.2 Over and above the 27,540 degree holders and 51,450 diploma holders resulting from the admissions at the end of the Third Plan, provision should be made during the Fourth Plan for an increase by 10,000 at degree level and 32,100 at diploma level by expansion of existing institutions, introduction of part-time and correspondence courses, and opening of a few polytechnics. These recommendations are being examined by a Committee headed by Dr. V. K. R. V. Rao and the report is expected shortly.

4.3 As the manufacturing, constructional and processing industry is developing on a large scale, and the nature and scope of work and responsibilities of technicians are becoming more and more precise, the number of technicians required in different areas of industrial work is also growing. Hence a close involvement of technical institutions with industry, is needed particularly in training technicians. Only through this process will the polytechnics become dynamic and establish a correct relationship between engineering as an academic discipline and engineering as professional work. Hence in reorganising diploma courses, provision should be made for functional specialization in particular aspects of engineering activity on the basis of cluster type formations. Sandwich type diploma courses of four years duration are suggested. A minimum of one year's practical training for the benefit of diploma-holders who have not undergone a sandwich course and for degree-holders in a field of engineering speciality, *e.g.*, machine construction and tool design, metal cutting, foundry and forge technology, production engineering, automotive engineering, structural design, roads, bridges, metallurgy of iron and steel with particular reference to blast furnace and steel melting, chemical plant (operation) processes and control, etc., with a stipend per month of Rs. 300 for graduates and Rs. 200 for diploma-holders is recommended. The purpose of this scheme is: (i) to create a consciousness in Indian industry that our system of technical education needs to be strengthened by organized apprenticeship; (ii) to give opportunities to the large number of fresh graduates and diploma-holders passing out of technical institutions who wish to equip themselves with practical experience without committing themselves to a particular job and with the sole intention of enriching their technical competence; and (iii) to make it incumbent on engineering educators to train a corps of engineers and technicians who will be able to meet the varying demands of industry and who can adapt themselves to changing technology.

4.4 It is estimated that during the next ten years, 15,330 teachers for engineering colleges and 18,670 teachers for polytechnics will be required This demand is expected to be met by training Lecturers for engineering colleges under the Teacher Training Programmes and for polytechnics in the Regional Teacher Training Institutes and absorbing the technology graduates of Regional Colleges of Education. The staff can be trained further by deputation to Summer Institutes and for refresher courses; for higher studies and for industrial training during vacations or longer periods.

4.5 Indian industry has reached a stage where well-educated and well-trained skilled workers are demanded in increasing numbers. For the Fourth Plan over a million workers will be required. The multipurpose schools neither diversify secondary education from the point of view of training students for gainful occupations in life, nor do they reduce pressure on Universities for higher education. The Junior Technical Schools though designed specifically to fulfil the objectives of technical, vocational education have not made any large impact on the enrolment. The Industrial Training Institutes give intensive training and serve very well the purpose for which they are intended. The present Junior Technical Schools to be redesigned as specifically terminal in character, will have to be enlarged to admit a large number of students.

Report of the Education Commission

5.1 The Report begins by observing that 'The destiny of India is now being shaped in her class rooms......In a world based on science and technology, it is education that determines the level of prosperity, welfare, and security of the people. One-half of our present population of 50 crores is below 18 years. Over the next 20 years the population is likely to increase by 25 crores. At present, we have over 500,000 educational institutions with over 2 million teachers and 70 million students, which, by 1985, will become 170 million or about equal to the total population of Europe Hence the size and complexity of these problems argue the need for rapid action in evolving a sound education policy. A good and purposeful education should consist of at least four basic demands: literacy, numeracy, work-experience, and social service. Therefore the future trend of school education will be towards a fruitful mingling of general and vocational education—general education containing some elements of pre-vocational and technical education, and vocational education, in its turn, having an element of general education. In the kind of society in which we will be living increasingly in the coming years, a complete separation between the two will be not only undesirable but impossible. Hence for the planned development of the national economy we need a large-scale expansion of enrolment in engineering and agriculture and at the post-graduate level in pure science subjects.

5.2 A sound system of technical education results from a partnership between industry and the educational authorities. It can be either institution-based with training completed within industry or industry-based with part-time education or re-training being provided by the institutions. Industry must accept to play its full share in the preparation of those who will later man its services, by providing courses, co-operating in sandwich training schemes, making available facilities and staff for part-time teaching, assisting in the drawing up of courses of study and making technical careers attractive. A central scheme of subsidy to industrial concerns providing training facilities and a separate budget provision for this work in public sector undertakings are suggested.

5.2.2 By 1980, 20% of enrolments at lower secondary and 50% beyond Class X should be in part-time or full-time vocational and professional courses.

At present 113,000 semi-skilled and skilled workers are trained in 356 I.T.I.'s. In addition, technical high schools, junior technical schools (103 with 18,000 capacity), artisan centres of Khadi and Village Industries Commission trade schools and multipurpose schools train such personnel. The Fourth Plan provides for doubling the output of the I.T.I.'s. As a significant percentage of those passing out of junior technical schools rejoin the educational stream, these schools, to be renamed as technical high schools, must unmistakably be designed as schools for the training of skilled workers and not as a poor alternative to general secondary education or as a more costly preparation for entry into polytechnics. The courses offered should be clearly terminal. The length of courses need not be a standardized three years, but may vary from course to course, with a strong emphasis on experimental work and applied sciences. Redesigned on these lines, they could be a valuable alternative to I.T.I.'s in preparing skilled workers and to general secondary schools.

Technicians are, in the main, trained in three-year diploma courses in polytechnics of which there are 274 (plus 17 girls polytechnics). Many graduate engineers are in fact doing what should be regarded as technicians type of work. This is a wasteful use of their skills and an unnecessary charge on training costs. In foreign countries the ratio of engineer to technicians is 1:3 going up to 6. In India, it is now 1:1.4. The Fourth Plan proposals would increase this to 1:1.5. Our goal should be to improve this to 1:2.5 by 1975 and 1:3 or 4 by 1985. The criticisms levelled against our polytechnics are: (i) the courses offered by them tend to be diluted forms of engineering course; (ii) the training is insufficiently practical or industry-oriented; and (iii) wastage is high ranging between 30 to 50%. The remedial measures are: periodically review syllabuses in cooperation with industry and in terms of levels and clusters of skills and responsibilities for technicians; provide post-diploma courses for catering to the category of higher technician, technician-engineer, or technologist; locate polytechnics in industrial areas; provide for one year's practical training or four-year sandwich course; appoint adequate and properly paid staff who combine practical experience with academic qualification, etc.

Other vocational education can be given by introducing courses in commercial, scientific, and industrial trades; running sandwich or part-time courses for employees; conducting correspondence and vacation courses; etc.

5.2.3. Since progress in industrialization will depend more and more on a deep understanding of the basic sciences, the training of engineers becomes more and more institution-based. This is as it should be. But it should be recognized that 'practicals' have always contributed greatly to industrialization, practicularly in its early stages. In 1964, there were 133 degree level institutions. Again recruitment of well-qualified B.Sc. students in engineering colleges, especially in subjects like electronics, instrumentation, etc., should be encouraged. Teaching of basic sciences in engineering colleges must be strengthened. Practical experience during vacation for full-time students, in cooperation with industry is recommended from the third year. Production experience should be an integral part of the curriculum. Besides ensuring a stronger link with industry and giving a more practical bias to training, such a practice will shorten the period before which an engineer is productive, will permit students to earn while they learn, will draw industry and institutions closer together and permit some students in non-industrial areas to follow courses. Workshop practices can be made more production-oriented. Groups of students can be set production problems, taken from industry as project work. Teachers and university departments should be encouraged to undertake consultancy for industry and should themselves work in industry in vacation periods. Frequent professional contacts in summer institutes between teachers and industry should be organized. Research design projects should be introduced in the curriculum. Public exhibition and prizes for such work could be organized.

5.2.4. Post-graduate courses are run in 41 centres (about 2,000 enrolment in 1965-66) with only 7 offering facilities for post-graduate diploma and Ph.D. (12 capacity). For admissions, the candidates should have at least one year's experience in industry. Engineering research should be directed more and more towards the problem of industry and larger number of those taking post-graduate courses should be sponsored by industry.

5.2.5 While I do not propose to deal with the recommendations relating to Directors or eminent educationists becoming Education Secretaries to Government, formation of the Indian and State Educational Services and implementation of the A.I.C.T.E. scales of pay in technical institutions, I invite your special reference to the following two recommendations: (i) The Directorates of Technical Education should be empowered to recruit staff needed for education institutions, thus removing a number of procedural delays which now occur through the use of State Public Service Commission channels; and (ii) The Principals of Colleges should have full discretion to decide matters relating to the building up of educational facilities in their institutions within the financial ceilings and policy guidelines laid down. The Principal or his nominee should be the Chairman of all Sub-Committees set up for the development of courses and facilities and should have full disciplinary powers vested in him in respect of the appointment of staff.

Technical education in Kerala

6.1 Most of the schemes envisaged in the Third Plan have been executed, the expenditure being Rs. 385.69 lakhs against a provision of Rs. 378 lakhs. At the end of the Third Plan, we had 6 engineering colleges (intake 1,160), 17 polytechnics including 3 women's polytechnics (intake 2,478), 20 junior technical schools (intake 1,200) besides a number of other minor institutions (both Government-owned and aided). As almost all these institutions have now completed five years after establishment, they have become items of committed expenditure and are therefore taken over to non-Plan schemes. The expenditure on these items alone will come to about Rs. 6 crores during the Fourth Plan.

6.2 The Plan provision envisages an expenditure of Rs. 5.6 crores in the State sector besides post-graduate courses and part-time courses in the Central Sector. All the existing courses will be continued and the emphasis will be on strengthening of the existing institutions from the point of view of staff, buildings and equipment. The proposed new schemes are: establishment of a School of Printing Technology at Shoranur offering courses in letter-press and lithography; development of the School of Arts, Trivandrum; opening of a Food Polytechnic at Kalamassery offering courses in bakery, cookery, canning, etc.; and starting new centres for running diploma in commercial practice courses. The expansion of the engineering colleges and polytechnics and starting of new polytechnics will be taken up for consideration only after receipt of report and recommendations of Dr. V. K. R. V. Rao Committee referred to earlier in 4.2.

Conclusion

I thank you for the patient hearing and am sorry to have tested your patience with such a long speech. I am confident that with liberal provision of funds by Government and the guidance and cooperation of the engineers of high ideals and high abilities of the State, it will be possible to develop technical education in the State on sound lines, carry it to peaks of excellence and enable it to play its rightful part in the agricultural development and industrialization of India in general and Kerala in particular.

Report of Shri K. K. Nambiar, Chairman, Civil Engineering Division

The Editor regrets a few omissions and printer's errors in the report presented by Shri K. K. Nambiar (M.), Chairman, Civil Engineering Division, in the Closing Session of the 47th Annual Convention, held in Bombay during February 24-28, 1967 (Bulletin, vol. 16, no. 7, March, 1967, p. 10). *The report may please be read as follows.*

(i) Shri K. K. Nambiar (*M.*), Chairman of the Civil Engineering Division who took the Chair during the Paper Meetings in the Division, said that the Civil Engineering Division had a short Session on the 25th afternoon and again had forenoon and afternoon sessions on the 27th February, 1967. On the 25th, the proceedings started as usual with the Chairman's Address. Being the Chairman of the Civil Engineering Division as well as the Chairman of the Roads and Road Transportation Group, the addresses were combined into one.

On the Civil Engineering side, he made a brief review of some of the new developments in the various fields of civil engineering—new methods and techniques of construction, glass fibre reinforced plastics, glass fibre reinforcement for concrete, ferro-cement, polymer cement, epoxies, etc., as well as new techniques in foundation engineering and also industrialized systems of construction—for obtaining large covered areas without any columns or supports; the use of the bridge superstructure type of construction adopted by Prof. Nervi to suspend the roof was worthy of special notice.

Coming to Roads and Road Transportation, he reviewed the important developments since his address last year and made particular reference to the report of the Tarlok Singh Committee on Transport Policy and Coordination and commented on their recommendations regarding roads and road transport. It was pointed out by him with facts and figures how the road transport industry in India was bearing the heaviest taxation in the world and hoped that the Keskar Committee which is going into the question of taxation on motor transport would suggest that any further dose of taxation on road transport would be the last straw on the camel's back—would be virtually killing the goose that lays the golden eggs. He also pointed out recent instances of lack of coordination between road development and land use planning and mentioned the part being played by the Metropolitan Transport Study Team in this regard. Immediately after his Address, the paper entitled 'Design of Reinforced Concrete Grid Floors by Collapse Load Method' by Shri M. Das was discussed.

Dr. Soretz could not undertake the journey due to a sudden indisposition and Dr. Helmut Holzenbain, his associate, was good enough to come and deliver his speech on 'Ribbed Torsteel for Use as Reinforcement' with a large number of slides on the 27th at 12.00 noon. He spoke at length on concrete technology and corrosion of reinforcing steel, the importance of impermeability and adequate cover for reinforcing steel. Unlike ordinary m.s. reinforcement the deformed bars and particularly ribbed Torsteel made in grades 40, 50, 60 could take very much higher stresses without causing wide cracks on the tension side. A good reinforcement is that which gives minimum value to the largest crack when the steel is stressed to its safe limit. Torsteel prevents slip of bond. It is made by cold working and during the process the steel is automatically tested—any flaws in hot rolling would indicate itself or cause failure.

Shri Nambiar said that the highlight of yesterday's session was the presentation of the paper on 'Urban Transportation' by Shri P. G. Patankar. Ten members came forward to offer comments. Shri R. N. Joshi who opened the discussion gave the suggestions to tackle the mass transport problem in Bombay City and commented on Wilber Smith's proposals.

The afternoon session on 27th February was opened by Shri K. F. Antia, in the absence of Shri Nambiar. Dr. Desayi presented his paper on 'An Investigation for the Prediction of True Ultimate Moment of Reinforced Concrete Beams'. This was followed by the paper, 'Hydrodynamic Pressures Generated During Earthquakes on Structures Surrounded by Water' by Bharat Singh and A. K. Jain.

The President then proposed a Vote of Thanks to Shri K. K. Nambiar for the success of the technical meetings in the Civil Engineering Division *(Applause)*

Summaries of Papers Published in the Journal, vol. 47, no. 8, pt. EL 4, April 1967

ELECTRICAL ENGINEERING DIVISION

621.317.4

1. **A.C. Magnetic Testing under Superposed Transverse Polarising Field. Prof. J. K. Choudhury,** *Associate Member,* **R. K. Mondal,** *Non-member,* **and Dr. S. N. Bhattacharyya,** *Associate Member.*

The paper discusses how the A.C. magnetic properties are influenced by a transverse polarising (direct) field superposed on an alternating field in the core of the material under test. Investigations were carried out on ring samples of Stalloy and Mumetal subjected to an alternating magnetization of 50 cycles per sec. A few oscillographic records are included in the paper to demonstrate the nature of influence of the cross-polarising direct field on the exciting current and dynamic *B-H* loop of materials under test.

621.313.224-8

2. **Effect of Switching and Overload on a High Current Low Voltage Thick Cylinder Commutatorless D. C. Generator. Dr. A. K. Dasgupta,** *Member.*

In this paper, equations have been formulated for the skin effect and eddy currents generated in thick cylinders of machine under transient switching condition and the eddy current time constant has been found out. It is shown that the time constant of a machine with thick cylinders are sometimes many order larger than the time constant of a similar machine with thin copper cylinders.

621.317.6 : 621.3.011.6

3. Correlation between Time Domain and Frequency Domain. Prof. M. K. P. Mishra, *Non-member.*

In this paper the relationship between the time domain and the frequency domain is shown mathematically and their response explained. With the help of an example, an attempt has been made to show the practical relationship between the time response and the frequency response of a system.

621.313.33.001

4. Linear Analysis of Three-Phase Solid Iron Rotor Induction Motor Using Transmission Line Analogy. M. R. Patel, *Non-member.*

An analogous linear approach for analysing the three-phase solid iron rotor induction motor is presented in the paper. The stator is assumed to have infinitely permeable smooth (untoothed) structure and the rotor a finite constant permeability and no curvature. The electromagnetic field equations are derived for rotor region from Maxwell's equations. These equations are similar to transmission line equations suggesting to set up an analogy between the induction motor and the transmission line. Applying appropriate boundary conditions, it is seen that the motor is equivalent to infinitely long transmission line.

621.315.001

5. Determination of the Optimum Value of the Series Compensation of a Transmission Line from the Generalized Circuit Constants and Its Experimental Verification. G. P. Purakayastha, *Associate Member,* **and K. V. Desikachar,** *Non-member.*

The purpose of the present paper was to study the degree of series compensation on steady-state stability limit of a transmission line. A 300-mile long transmission line of 220 kV rating with twin conductors was taken for study by means of an artificial transmission line having the same characteristics.

621.316.728 : 512.8

6. Economic Load Despatch with the Help of Matrix Mathematics. S. A. Quader, *Member.*

Every electrical utility would like to operate at the minimum cost particularly when there are several power houses catering to the load in the area served by the utility. There must be some means of determining the load allocations to the various power houses, easily and as quickly as possible. It was felt that matrix mathematics could be conveniently applied for the purpose, if a computer is not available. With a little practise, matrices can be drawn up and the desired solution obtained in not too long a time. As is always the case in mathematics, nothing registers more than the details of a solution. An example has been worked out so that those interested in the problem could follow it, step by step. It would be clear that any number of assumptions could be made for which final matrices could be drawn.

621.313.33 : 621.3.016.1

7. Torque Angle Analysis of Induction Motor under Balanced and Unbalanced Conditions. I. Gopal Reddy, *Non-member.*

Reliable equations of performance for the three-phase induction motor are developed in terms of the space angles between the stator and rotor magnetomotive force waves. This results in a new treatment and yields a new form of impedance locus. The expressions for slip, current, and torque are obtained in terms of these angles for unbalanced operations. The results obtained by this method are compared with the test results.

621.313.2.077.3.001

8. Flow-Graph Theory—a Study of D.C. Motor Dynamics. L. B. K. Sastry, *Non-member.*

This paper presents a new approach for the determination of the dynamic characteristics of a D.C. shunt motor by using signal-flow graph analysis. In the first instance, a signal-flow diagram representing the motor is constructed. The desired characteristic of the motor is obtained from the signal-flow diagram with the help of the graph transmission. This method enables to make a rapid study of the behaviour of the motor practically by inspection of the flow-graph. The calculated values are verified by a dynamometer load test on a D.C. shunt motor. It is found that a close agreement of the results is obtained.

621.315 : 621:316.93

9. Shielding of High Voltage Transmission Lines from Direct Strokes of Lightning. O. Thimmaiah, *Member.*

Overhead transmission lines as a whole are exposed to the high potentials of the atmospheric origin induced by the lightning strokes. Lightning strokes cause disastrous results and are considered to be (i) potential saboteurs and killers, and (ii) one of the principal causes of fire ranking fourth among the causes of fire. Without lightning protection such as arresters and shielding of transmission lines, systems would be subjected to frequent service outages and damages to equipment. This paper deals with the shielding of transmission lines with a view to reduce the outages on the lines and damages to equipment. The article also deals with configuration of power and ground wires consistent with economy to obtain the maximum benefits of shielded wires.

INSTITUTION NOTICES

Draft Indian Standards

The following draft Indian Standard have been issued recently.

1. Draft Indian Standard Code of Building Bye Laws (Revision of I.S.: 1256-1958)—Doc: BDC 25 (1230)

This code stipulates standards, provisions and requirements for safe and stable design, methods of construction and sufficiency of materials in structures and regulations for maintenance of equipment, use and occupancy of all structures and premises.

Members may send their comments on this draft code before May 5, 1967, to Maj.-Gen. R. A. Loomba (M.), Director General, Border Roads, Kashmir House, P.O. D.H.Q., New Delhi, who is the Institution representative on the Sectional Committee dealing with this Standard.

2. Draft Indian Standard for Supply conditions for Threaded Fasteners—Doc: EDC 27 (1301) (Draft Revision of I.S.: 1367-1961).

3. Draft Indian Standard Specification for Black Hexagon Bolts, Nuts and Lock Nuts (6 to 39 mm.) and Black Hexagon Screws (6 to 39 mm)—Doc: EDC 27 (1309) (Draft Revision of I.S.: 1363-1960).

4. Draft Indian Standard Specification for Precision and Semi-Precision Hexagon Bolts, Screws, Nuts and Lock Nuts (6 to 39 mm.)—Doc: EDC 27 (1310) (Draft Revision of I.S.: 1364-1960).

Members may send their comments on these draft standards before April 22, 1967, to Dr. S. P. Luthra (M.), Senior Professor and Head of Applied Mechanics Department, Indian Institute of Technology, Hauz Khas, New Delhi 16, who is the Institution representative on the Sectional Committee dealing with these draft standards.

Copies of the draft Standards may be obtained from the office of Indian Standards Institution, 'Manak Bhavan', 9 Bahadur Shah Zafar Marg, New Delhi 1, or from its branch offices at Bombay Mutual Terrace, Sandhurst Bridge, Bombay 7; 5 Chowringhee Approach, Calcutta 13; 14/69 Civil Lines, Kanpur, or 54 General Patters Road, Madras 2

Payment of Membership Subscription and Examination Fees

We are pleased to inform the members that the facility of remitting membership subscriptions and examination fees only has been extended to the State Bank of Travancore in addition to the State Bank of India, State Bank of Bikaner & Jaipur and State Bank of Mysore. Members desirous of availing the facility may remit their Subscriptions and Examination fees through any branch of the above mentioned banks with relevant cards duly filled in.

Members are requested to make it a point to fill up the Subscription and Examination Fee remittance cards properly quoting name, address and membership number at the time of making remittance through Bank to avoid the risk of non-adjustment in the proper account. **After remitting subscription through Bank, Card A should be preserved by the member as a proof of deposit and should not be sent to the Headquarters.**

Remittance on account of transfer fees, registration fees, application deposit, etc., should not be made through Bank with the help of Subscription Cards.

INSTITUTION NEWS

Dr. T. Sen Joins Union Cabinet

Dr. Triguna Sen, President of the Institution for the Sessions 1962-63 and 1963-64, and a Honorary Life Member, has been selected by the Prime Minister as Minister of Education, Government of India. This is a unique occasion when a member of the engineering profession has been admitted in the Union Cabinet and hence, is hailed by the engineers in the country as the beginning of a new era.

Before joining the Cabinet, Dr. Sen was the Vice-Chancellor of the Banaras Hindu University where he introduced many reforms in a short space of time. He was also the first Rector (Vice-Chancellor) of the Jadavpur University since its establishment in 1955 to 1966.

Dr. Sen was also a member of the Education Commission set up by the Government of India, whose report was welcomed by experts in the educational field with considerable interest.

In 1957 Dr. Sen went to America and Europe to study the system of education in different Universities. Again in 1959 he went to Germany to study the administration of Universities, in 1960 to France to study the systems of education in higher secondary schools there, and in 1963 to Czechoslovakia to study the system of University and Technical Education.

In addition to his duties as Vice-Chancellor of Jadavpur University, Dr. Sen was elected Mayor of Calcutta in 1958 and again in 1959. He was President of the Association of Principals of Technical Institutions in India for two terms, in 1961 and in 1962. He was elected President of the Inter-University Board of India and Ceylon in 1963.

He was awarded the Padma Bhusan by the Government of India in 1965.

Dr. K. L. Rao Continues as the Minister for Irrigation and Power

Dr. K. L. Rao has been elected to the Lok Sabha uncontested from his Andhra Pradesh Constituency and continues as Union Minister for Irrigation and Power. The President of the Institution for the Sessions 1958-59 and 1959-60 and its Honorary Life Member, Dr. Rao's first appointment as Union Minister of Irrigation and Power in July 1963 was hailed as a significant event by the engineering profession.

Dr. Rao was the Chairman of the Civil Engineering Section of the Institution of Engineers (India) from 1957 to 1959 and was a Vice-President of the International Conference on Soil Mechanics and Foundation Engineering since 1957 and Chairman of the Indian Society of Soil Mechanics and

Foundation Engineering from 1958 to 1960. He was also President of the Central Board of Irrigation and Power for 1960.

Dr. Rao has travelled extensively in the world and visited dams and river structures in the United Kingdom, the European Continent, the United States, the U.S.S.R., Egypt, Japan and China, and is a familiar figure to distinguished engineers in this field of those countries. His reports and analyses of these structures have contributed greatly to the design of similar structures in this country.

In 1963, Dr. Rao received the Padma Bhusan awarded by the Government of India.

Bilateral agreement with the American Society of Civil Engineers

A letter was received from the Executive Secretary of the American Society of Civil Engineers in connection with a bilateral agreement on exchange of membership guest privileges. The matter was discussed at the 448th Meeting of the Council held in Bombay on February 26, 1967, and it has been accepted that the bilateral agreement on exchange of membership guests privileges be established on payment of $5 00 as annual subscription. This arrangement will entail a member of this Institution to certain privileges detailed in the 'Memorandum of Agreement on Exchange of Membership Guests Privileges' given below.

(i) A wallet card identifying the member as a guest of the Host Society for assistance in professional contacts, visits, etc.

(ii) Registration in special Foreign Engineer Guest mailing lists to be maintained by the Host Society and any of its local sections in which the guest member might locate.

(iii) Regular mailings of notices of all technical and social meetings of the Host Society, national or local, with the privilege to attend and participate at regular membership registration fees.

(iv) A subscription to the periodical magazine or newsletter of the Host Society.

(v) Privilege to purchase or subscribe to any publications of the Host Society at the same discounted rates extended to its own members.

Upon presentation of a letter of introduction from the Secretary of this Institution to the Secretary of the American Society of Civil Engineers, either in person or in writing, the member of this Institution will be extended the above privileges on payment to the Host Society of an annual subscription fee of $5.00 (U.S.). Such subscription fee is payable annually in advance for the term of guest enrolment.

Guest Night Programme of the American Society of Civil Engineers

In a letter addressed to Maj.-Gen. Harkirat Singh, Past President and Adviser (Construction), Planning Commission, Government of India, New Delhi, Mr. I. P. Gould, President of the Metropolitan Section, American Society of Civil Engineers, New York, says, 'In the geographical areas of our local section, which is the Metropolitan Section, ASCE, there are many engineers who are interested in foreign lands and the languages spoken there. To serve these engineers, the Foreign Engineers Guest Night programme was introduced in 1964. The purpose of our programme is "to enjoy lectures or informal conversational evenings with distinguished foreign engineers and to listen to ideas and experiences expressed in their native tongues."

For the coming 1966/1967 season, our plans include Guest-Nights with Italian, Indian, and Australian speakers, and the language in the case of the latter two meetings will be English.

It is difficult to pin down a date when a speaker comes from abroad. Some of our speakers were provided, however, by international bodies and concerns with headquarters in New York City. When the speaker comes here in the course of his usual official or business visits to America, the arrangements for his lecture are made with his itinerary fully in mind.

Consequently, we would be very happy to learn from you that the Council of the Institution of Engineers (India) is pleased with our thought to feature an Indian Guest Night during our coming season.'

Subsequent to this, Shri S. D. Sharma, a member of the American Society of Civil Engineers, visited Calcutta and discussed with the Secretary regarding the Guest Night. This proposal was further discussed at the 448th meeting of the Council held in Bombay on February 26, 1967, and was approved. Members visiting New York and wishing to take part in the Guest Night Programme may contact Mr. S. D. Sharma, at his office at Tippetts-Abbett-McCarthy-Strainton, 375 Park Avenue, New York, N.Y. 10017 (Tel. PL-5-2000) at least two months earlier to their proposed visit.

Opening of Post Office in the Headquarters Building

A new Post Office has been opened at the new building of the Headquarters Office of the Institution. Inaugurated by the Secretary on March 22, 1967, in the presence of Shri K. R. Moorthy, Director of Postal Services, and Shri J. Datt *(M.)*, Member of the Institution Building Committee, this new post office will be known as Gokhale Road Post Office. Shri J. Datt thanked the postal authorities for opening the post office in the Institution premises.

Symposium on 'Roads and National Highways', Srinagar, May 26-28, 1967

During the 448th Meeting of the Council held in Bombay on February 26, 1967, the President, Major General S. P. Vohra, stated that as a regular feature at the time of each Council Meeting one of the Divisions should hold a symposium on a topic which is of importance to the place of meeting. Accordingly, keeping in view the strategic importance of roads in Jammu and Kashmir, and also the fact that they form the life line of this border State, it has been decided to conduct a Symposium on 'Roads and National Highways' during the next Council Meeting to be held in Srinagar from May 26-28, 1967. Members interested to submit papers for the Symposium may do so by sending a copy of their contribution to Shri K. K. Nambiar *(M.)*, Chairman, Civil Engineering Division, c/o. The Concrete Association of India, 'Cement House', 121 Queen's Road, Bombay 1, and a copy to the Secretary at the Headquarters.

Some suggestions by Shri K. K. Nambiar for discussion at the Symposium are given below:

1. The National emergency of hostilities with the neighbouring countries of Pakistan and China have amply demonstrated the need for a vital network of roads along the border and also the role that even mobilised civilian road transport could play in protecting the country. Commendations galore went to the Railways for backing up the transport needs of the hostilities but it was quite obvious that what served the defence, was at the sacrifice of other pressing needs affecting the economic development of the country during this same period. If, however, a strategic network of highways of adequate capacity had been available in the country to expeditiously move the mobile units of the army on their own power considerable time and money could have been saved in organising the necessary manoeuvres. The concerted efforts of the Border Roads Organisation in achieving such quick and good results in developing roads in border areas would serve as an example for fulfilling the needs of strategic roads in other parts of the country as well. This type of development of vital road links on a war footing will also strengthen the overall transport capacity of the country by its various peace time uses.

2. Acceleration of roads programmes has been considered well-nigh impossible without resort to mechanisation of road construction. The climate in this country has not been very favourable to widespread use of machinery due to the fact that adequately sized jobs and methods are not planned for continuous utilisation of equipment. The recourse to import of mechanical equipment for tiding over the needs of some special projects like IDA Works has also revealed the weakness in the present arrangements of substituting components or parts of equipment from indigenous sources, some times delays arising therefrom leaving machinery and investment idle over years. Suggestions have also been offered for regional centralized machine pools and equipment-use training programmes. It remains to be examined how these ideas can be put into effect.

3. A good deal of research has been carried out both by the Central Road Research Institute and by the State Highways and other laboratories in this country to amply demonstrate that new methods of road construction compare very economically with existing methods at the same time lending themselves to better quality control. The utilisation of the results of such research has been very insignificant as no bold programmes are encouraged either by the Centre or by the States. This situation is suggestive of some gaps in the organisation which require to be filled.

4. It is a well recognized fact that a small mileage of the entire system of the country's highways carry a major portion of the traffic. Steps for upgrading such road lengths to the required geometrical and structural standards would be amply justified from point of view of economy of road construction and maintenance as well as savings in road transport operation costs. For a long time this matter has not been given due consideration and presently in view of the fact that regional transportation survey units have completed their work resulting in the pin-pointing of different lengths of roads, it appears very desirable that certain corrective measures are initiated both

in the planning work and allocation of resources towards achieving the above objective.

5. Whilst for apparent reasons we have not been able to adopt uptodate techniques of road construction on a large scale in this country it is surprising that no steps have been taken even on an experimental scale. It is high time that fairly widespread scheme for such experimental projects are initiated by all States, so that we do not lag behind other countries in developing the techniques.

FORTHCOMING EVENTS

Symposium on 'Pore Pressures and Shearing Resistance of Soils', New Delhi, May 12-13, 1967

The Indian National Society of Soil Mechanics and Foundation Engineering is holding a Symposium on 'Pore Pressures and Shearing Resistance of Soils' in New Delhi, from May 12-13, 1967, concurrently with the 9th Annual General Meeting of the Society.

Papers on the following topics will be discussed at the Symposium.

(i) Basic Principles—Theories and soil testing

(ii) Selection of the type of test, test procedure, and equipment for laboratory as well as field tests

(iii) Application to stability analysis in relation to various critical conditions including problems involving earthquake, creep, progressive failure, cracking of embankments

(iv) Studies in relation to special types of soils, such as residual soils, expansive clays, fissured clays, highly plastic clays, aeolian deposits, shales and partly cemented soils.

Joint Engineering Management Conference, San Francisco, October 9-10, 1967

The 15th Joint Engineering Management Conference will be held in San Francisco, U.S.A., from October 9-10, 1967. Eight engineering societies sponsor and participate in the joint meeting, which will study problems common to all. The theme of the conference will be 'Managing Engineering Manpower'. The two-day meeting will consist of four sessions dealing with (i) engineer-manpower planning; (ii) problems of acquiring engineers, recruiting techniques and policies, and the creation of a favourable recruitment climate; (iii) the problem of motivating engineers and using them effectively and will seek ways to improve engineer-scientist-manager relationships; and (iv) the problem of turnover and mobility among engineers—ways to hold turnover at acceptable levels without fostering stagnation and decline.

Further details can be obtained from M. D. Frankel, Muller, Jordan & Herrick, 545 Fifth Avenue, New York, N.Y. 10017.

5th International Symposium on the Chemistry of Natural Products, London, July 8-13, 1968

The 5th International Symposium on the Chemistry of Natural Products, will be held in London from July 8-13, 1968. The Scientific Programme Committee will consider papers of special interest and novelty in any branch of Natural Product Chemistry. Within the meeting it is proposed to organize separate sections on the following topics: (i) Physical methods including X-ray crystallography, (ii) Naturally occurring compounds containing metals; (iii) Biosynthesis; (iv) Proteins and endyme systems as related to organic chemistry; and (v) Other macromolecules of biological importance.

Further information can be obtained from The Secretary, 5th International Symposium on the Chemistry of Natural Products, c/o. The Chemical Society, Burlington House, London, W. 1.

Seventh World Power Conference, Moscow, August 20-25, 1968

The Seventh World Power Conference will be held in Moscow, U.S.S.R., from August 20-25, 1968. The theme of the Conference is 'World Energy Resources and Their Utilization for the Benefit of Mankind'.

The role played by power engineering in the economic development of countries has grown quickly in the course of the last few decades. The present period is characterized by the ever increasing use being made of fuel and energy resources, and the development of electrification. New countries—in Asia, Africa, and in other parts of the world—are being drawn into this process. This process stimulates the creation and development of new industrial centres, and helps to raise the living standards of the population in the countries which have only recently started to develop industrially.

The growth of world and national energy resources ensures an increase in energy and power consumption per worker and makes it possible to increase the productivity of social labour. The countries and regions which started to develop their industries earlier, and which have made wide use of the traditional energy sources, are now faced by the problem of introducing new fuel deposits into their national energy balances, and of making use of new sources of energy. The world is now on the threshold of transformations in the power-engineering industry which are of great significance for the progress of world engineering.

The discussion of the various aspects of the problem of the use of fuel and energy sources in 1968 will be fruitful, thanks to the rapid accumulation of knowledge of the construction and operation of fuel and power installations of great capacities, and the working out of new methods of extracting, processing and using fuels.

In these conditions the study of the successes achieved in the sphere of atomic power will also be of great interest. It may be supposed that in the course of the next few years, nuclear fuel will become an important and economic source of energy for many regions of the world. Also of great significance for the future of power generation is the development of new schemes for transformation of energy.

The methods of extraction, concentration and combustion of solid fuel including low-grade fuels are being perfected. The use of natural gas and oil for steam power plants is widening. Possibilities are appearing for the practical introduction of complex energo-technological utilization of fuel.

Some countries show a tendency to construct powerful hydro-electric plants in combination with a multi-purpose use of hydro-resources, in the first place, for purposes of irrigation. It is also necessary to study attentively the tendency towards further centralization of electricity production, its transmission and distribution, on the basis of using extra high voltages both in A.C. and D.C. transmission. At the same time, the question of making use of the advantages offered by direct current at lower voltages, is also of interest.

A great development is taking place in the field of the long-distance transport of fuel, especially of natural gas, oil and oil products.

Close interaction between the development of the fuel basis, the energy projects and electrification poses the urgent problem of planning, forecasting and working out of complex fuel and energy balances. A discussion on these problems will be of considerable interest for many countries.

In connection with the rapid progress in the sphere of computing techniques great attention must be given to principles and methods of solution of the complex problem of finding optimum versions of fuel and energy balances and of the operation of large electric-power systems.

The problems of increasing the efficiency of the consumers' power installations take a special place within the general problem of the use of energy resources. In the long run improvement in the work of the tremendous numbers of consumers' power installations can change the character of the power balance substantially. In this case, naturally, attention should first be given to processes in industry and in the home life of the population that consume great amounts of energy.

In accordance with the above, the Technical Programme comprises the following six divisions, each of them in their turn having sub-divisions.

Division 1—World Energy Resources and Their Utilization

1(a) National surveys of fuel and energy resources

1(b) Solid, liquid and gaseous fuels and the economic effectiveness of their utilization

1(c) The inexhaustible energy resources

Division 2—Energy Balance

2(a) Methods of compilation and estimation of energy balance sheets

2(b) Principles of rational compilation of balance sheets to make the most effective use of the energy resources

Division 3—Electric Power Generation

3(a) Development and improvement of electric power stations (including heat and power stations, pumped storage and tidal stations)

3(b) Atomic power stations, their economics and share in the power economy

3(c) New methods of producing electricity

3(d) Power systems and their interconnection. The role of high-tension transmission lines (except for the questions, falling within the scope of C.I.G.R.E.)

Division 4—The Transport Energy

4(a) National surveys of the methods of transporting solid, liquid and gaseous fuels

4(b) The economic and engineering aspects of the various means of transport of energy

Division 5—The Utilization of Energy

5(a) Rationalising the consumption of energy

5(b) Consumer installations and methods of their improvement

Division 6—Secondary Energy Resources

6(a) National surveys of the secondary energy resources

6(b) Methods of use of secondary energy resources.

The Institution of Engineers (India) is the Indian National Committee for World Power Conference and further details can be obtained from the Secretary on request.

Conference on 'Progress in Overhead Lines and Cables for 220 kV and Above', London, September, 16-20, 1968

The Power Division of the Institution of Electrical Engineers, London, is holding a Conference on 'Progress in Overhead Lines and Cables for 220 kV and Above' from September 16-29, 1968. The purpose of the Conference is to survey the field of extra high voltage overhead lines and cables and their associated equipment for A.C. and D.C. systems, and to indicate possible future developments in conventional and novel methods of power transmission. Exphasis in all contributions should be on new developments and procedures, and the economic result of technical policy and preference should be discussed. The scope of the Conference has been divided into the following categories in which subject matter has been indicated as a guide only.

Overhead Lines

Conductors and Insulators—Conductor selection; Conductor movement—use of dampers and spacers; Insulator selection; Insulating for polluted conditions; Radio interference and corona; and Direct current techniques.

Towers and Foundations—Mechanical loading; Electrical clearances; Tower design, shape and material; Foundation design; and Testing of towers and foundations.

Construction, Maintenance and Operational Experience—Profiling—sag and tension procedures; Installation and erection techniques; Major crossings; Uprating procedures; and Routine and emergency repairs.

Cable Systems

Materials, Design and Manufacture—Electric stress considerations; Special constructions; Sheathing developments; and Protective finishes.

Characteritics, Ratings and Performance—Electrical and other characteristics; Rating calculations—computerized techniques and analogue methods; Ratings—natural and forced cooled; Self contained and pipe cables; and Self-cooled cables.

Installation and Operation—Developments in laying methods; Joints and terminations; Hydraulic system planning and calculations; and Operating experience—cables—mixed systems.

Insulation Co-ordination

Matching underground cables to overhead lines, rating wise; Insulation co-ordination and lightning protection; and Effect of cable capacitance on system operation; and Surge amplitude limitation methods and economics.

Synopses should be submitted to the Conference Section by August 31, 1967. It will be necessary for those authors who are invited to prepare contributions based on their synopses to submit the full texts, of not more than 2,000-2,500 words, for consideration for inclusion in the Conference Programme by April 1, 1968.

Further details of the Conference and registration forms will be available from the Conference Section, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

Fourth International Congress of the International Council for Building Research Studies and Documentation, Ottawa and Washington, October 7-16, 1968

The Fourth International Congress of the International Council for Building Research Studies and Documentation (CIB) will be held in North America from October 7-16, 1968. The meetings will take place in Ottawa, Canada, from October 7-11, and in Washington, U.S.A., from October 14, 1968. The theme of the meeting will be 'World Building 1968—Cost and Quality'.

Further particulars can be obtained from The Secretary, 4th CIB Congress, c/o. National Research Council, Ottawa, Canada.

NAMES OF SUCCESSFUL CANDIDATES IN THE STUDENTSHIP AND ASSOCIATE MEMBERSHIP EXAMINATIONS HELD IN NOVEMBER 1966

The following candidates have been declared to have passed the Studentship and Associate Membership Examinations held in November 1966.

STUDENTSHIP EXAMINATION

Roll No.	Name of candidate	Roll No.	Name of candidate
St. 147	J. F. Fernandes	St. 204	S. W. Deshpande
St. 150	R. M. Desai	St. 326	B. Singh

STUDENTSHIP EXAMINATION—*contd.*

Roll No.	Name of candidate
St. 345	Nand Kumar
St. 356	P. K. Bagga
St. 361	H. R. Arora
St. 369	Baldev Raj Bahl
St. 402	B. K. Batra
St. 407	K. K. Sehgal
St. 411	Chaman Kaul
St. 574	R. B. Singhal
St. 580	J. C. Goel
St. 585	J. N. Sharma

Roll No.	Name of candidate
St. 626	J. Panduranga Pai
St. 631	K. Sasidharan
St. 658	M. R. Naidu
St. 666	C. Govinda Rao
St. 672	B. Achyutha Ramaiah
St. 807	N. Krishnan
St. 818	M. D. Dongare
St. 843	Y. L. Chopra
St. 848	T. Kunhayamu

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A

Roll No.	Name of candidate
8A	Jagbir Singh
23A	Indra Pal Gupta
90A	B. Sen
104A	Krishna Swaroop Gupta
105A	Manjit Singh
127A	Lalit Mohan Gupta
129A	Mahendra Singh
175A	R. K. Sharma
176A	R. S. Sharma
191A	H. S. Saxena
219A	Nand Kishore
228A	M. V. Raju
257A	Parshotam Jetharai Sharma
266A	M. M. Adkoli
271A	B. Singh
278A	A. K. Dam
288A	Pradeep Agarwal
290A	Salik Ram
294A	A. K. Jaiswal
326A	Adarsh Kumar
329A	D. K. Maji
381A	Roshan Lal Tuli
385A	Narendra Mohan Malhotra
386A	Krishan Ranjit Singh
387A	Babban Ji Chaubey
419A	Suraj Nath Srivastava
441A	G. M. Rangaiah
442A	L. Lakshmipathaiah
462A	L. H. Deshpande
470A	L. Sridhar
487A	Settappa
500A	N. Vaidyanatha Sarma
501A	C. N. Yoganarasimhan
506A	Narasimhachari Kannan
508A	S. A. Jagirdar
511A	K. P. Abhi Rama Murthy
515A	A. Sreenivasa Murthy

Roll No.	Name of candidate
518A	R. Varada Raju
534A	B. R. S. Rao
536A	K. N. Mruthyunjaya
538A	Chakrapani Soundarajan
542A	S. N. Aswathanarayana Setty
543A	Nuggihalli Gopal Kesari
547A	K. V. Srikantan
549A	C. G. R. Murthy
553A	J. R. Narasa Reddy
567A	Raghupathy
575A	A. R. Mohan
578A	K. S. Ranganath
593A	Miss S. Mohana
618A	M. P. Rao
627A	K. Bhakthavatsala Naidu
643A	K. R. Varada Rajan
651A	K. R. Satyanarayana
656A	C. D. N. Kumar
711A	C. Sathyanandan
743A	P. S. Sahay
755A	S. R. Rajan
764A	Lakshmanagowda Venkatesh
772A	Revinder Paul Sood
776A	H. Trimbak Kulkarni
780A	H. N. Biradar
791A	Mohan Petu Naik
836A	B. N. Gundu Rao
860A	K. S. Krishnamurthy
878A	T. P. Baranwal
889A	U. B. Rao
895A	G. Nagaiyan
900A	T. K. Vijayaraghavan
910A	R. Ranganathan
913A	E. V. M. Sargunar
940A	V. Chandrasekhar
955A	L. R. S. Mani
965A	Mahadeva Seetharaman

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A—*contd.*

Roll No.	Name of candidate	Roll No.	Name of candidate
975A	M. Ravindran	1686A	T. Satyanandam
1010A	I. R. Kapoor	1691A	T. V. S. Rao
1051A	R. M. Godkhindi	1692A	D. M. Baranwal
1059A	R. K. Bibikar	1693A	Arjun Kumar Sardana
1062A	B. K. Soni	1694A	Syed Alamdar Husain Rizvi
1095A	V. C. Kohli	1711A	U. B. Palsanekar
1102A	S. Srinivasan	1715A	Sushil Kumar Chhabra
1107A	S. K. Lall Dass	1721A	Baldev Singh Randhawa
1147A	M. K. S. Gautam	1733A	Kewal Singh Thind
1150A	Yogesh Behari Sharma	1748A	M. Venkataramani
1198A	G. S. Sen	1760A	P. Prema Chandran
1200A	Sudhir Kumar Gomasta	1762A	V. Balasubramanian
1240A	K. C. Eapen	1778A	V. Murugesan
1255A	Sunirmal Das	1801A	Darshan Kumar Thukral
1276A	Virendra Mohan Saxena	1816A	Ram Udar Sinha
1294A	P. V. Prabhu	1820A	P. V. Nazare
1300A	C. U. Maskeri	1831A	N. K. Udupa
1341A	S. Pradhan	1833A	S. C. Kapoor
1373A	T. S. Raghunath	1850A	S. S. Nimkar
1394A	N. V. Satyanarayana	1853A	S. P. Machave
1398A	Popuri Rama Rao	1858A	N. Iyengar
1420A	R. K. Chaurasia	1869A	K. P. Venkiteswaran
1422A	Ramji	1883A	R. V. Gulrajani
1441A	R. Balasuramanian	1888A	Dattatraya Damodar Dewal
1462A	I. M. Adthakur	1931A	Arvind Shankerrao Vaidya
1476A	P. C. N. Namboodiri	1941A	Jiban Gopal Chatterji
1484A	Deen Dayal Ramsnehi	1944A	S. M. Navgonker
1491A	N. P. Bansal	1952A	Chandur Hiranand Keswani
1492A	N. R. Garg	1973A	Jayanta Kumar Ghatak
1496A	K. V. Jos	1981A	P. Y. Kulkarni
1498A	K. Sivalingam	1987A	Joseph Canute Sequeira
1499A	Krishan Lal Gidar	2041A	G. Mahadevan
1500A	Jai Kumar	2118A	A. L. Shanbhag
1505A	V. S. Dixit	2119A	R. V. Mahale
1514A	Bhajan Singh Aneja	2164A	V. P. K. D. Mathur
1520A	N. V. Rayudu	2177A	A. J. Vazirani
1535A	S. Guruswamy	2182A	Biswanath Hari
1546A	B. Sanyasirao	2196A	R. L. Shrivastava
1553A	C. Janardhanan	2239A	Rabin Kumar Gangooly
1559A	Ish Kumar Arya	2240A	S. Mitra
1564A	Lakshmi Chand Gera	2316A	Chandidas Goswami
1605A	V. P. Varghese	2322A	Sibsankar Mazumder
1608A	P. S. Seshan	2326A	J. C. Mandal
1612A	Virandra Kumar Rastogi	2331A	B. C. Niyogi
1613A	Kanhyalal Malviya	2343A	S. K. Aich
1632A	C. L. Gupta	2348A	Ganga Ratan Damani
1650A	R. N. Chaudhary	2357A	D. Ray
1653A	Satish Chandra Garg	2360A	Shabbir Ahmed
1656A	Chander Parkash	2365A	B. Datta
1669A	Shyam Motiram Advani	2403A	A. K. Sarkar
1674A	Prakash Chandra Agarwal	2421A	Swarna Kamal Hajra

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A—*contd.*

Roll No.	Name of candidate
2432A	Ramaprasanna Majumdar
2464A	Gorananda Bhowmik
2484A	Asoke Kumar Kanrar
2499A	Gour Mohan Mukhopadhyay
2560A	Arun Chandra Ghosh
2561A	Prakas Chandra Ray
2569A	D. K. Mazumder
2588A	P. Pan
2642A	Mrinal Kanti Pal
2669A	Nilratan Bhattacharya
2670A	Murari Roychowdhury
2688A	Ranjit Kumar De
2689A	Sunil Kumar Koley
2704A	Bipul Bikash Bhattacharya
2722A	G. Bhattacharyya
2776A	Syam Sundar Basu
2784A	D. C. Srivastava
2803A	Tapan Kumar Mitra
2804A	D. Bhattacharyya
2816A	Subrata Majumdar
2825A	Ant Anant Ganu
2826A	Chandanmoy Lahiri
2836A	Ashok Kumar Roy Chowdhury
2838A	S. K. Bandyopadhyay
2849A	A. K. Mukhopadhya
2856A	Tridib Kumar Chattopadhya
2857A	Kaushal Kishore Singh
2872A	Dibyendu Kumar Maity
2887A	S. K. Das
2946A	Lakshmiprasad Ghosh
2958A	Bani Mohan Mitra
2960A	Mrinal Kumar Mukhopadhyay
2987A	S. K. Bhattacharjee
3028A	D. Kanjilal
3055A	Pradip Kumar Nandi
3065A	Brij Mohan Prasad
3105A	S. P. Bose
3115A	A. K. Chakravarti
3124A	A. K. Sen
3179A	Nalini Ranjan Ghosh
3252A	Dilip Kumar Chatterjee
3318A	R. Ramasubramanian
3326A	Ratan Lal Sharma
3329A	K. Mukhopadhyay
3352A	M. Ghosh
3358A	Sitendra Prasanna Basu
3365A	A. K. Chaudhuri
3401A	S. Som
3417A	P. Datta
3496A	M. Singh
3511A	Manohar Lal Chodhary
3538A	Trilok Chand Joshi
3539A	Subhash Chandra Sehgal
3552A	Anand Kumar Gupta
3577A	Varinder Kumar
3588A	R. Singh
3591A	Girdhari Lal
3594A	Virindra Kumar Bahl
3613A	Dharmesh Kumar Ghand
3618A	Jagan Nath Garg
3631A	B. Singh Rai
3657A	Ramesh Chandra
3683A	Ramesh Kumar Jhingan
3687A	S. Kumar
3693A	Randhir Chand Sharma
3695A	Amar Singh
3730A	Purshottam Lal Saini
3740A	B. Khurana
3751A	R. K. Aneja
3772A	Harbans Singh Gill
3809A	Vasv Dev
3834A	S. S. Redu
3842A	Chaman Lal Gupta
3850A	S. D. Sharma
3871A	A. C. Narula
3880A	Moti Ram Mangal
3881A	Lakhwinder Singh
3884A	Raghbir Singh
3902A	B. D. Sharma
3907A	Bipin Kumar Nanda
3916A	N. K. Mohanty
3921A	Rabindra Nath Padhi
3923A	P. Misra
3946A	Harihar Hati
3979A	Dasharatha Mekap
3980A	Simanchal Mohapatra
3981A	Gopinatho Padhy
4020A	S. N. Dash
4026A	Ramanath Sarangi
4027A	G. S. Subramanyam
4028A	N. C. Pradhan
4029A	Sachidananda Dalal
4032A	Rabindrayan Mohapatra
4038A	Sulapani Ratha
4040A	Sudarshan Panda
4086A	Jasbir Singh Bhatia
4088A	S. Singh
4091A	B. P. Singh
4099A	S. K. Khurana
4122A	Jagdish Chandra Patel

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A—*contd.*

Roll No.	Name of candidate	Roll No.	Name of candidate
4193A	Ramesh Kumar Kapoor	4735A	Govind Ballabh Rawat
4237A	Om Prakash Lal	4743A	Romesh Chander Bhatia
4249A	Jagdish Singh Bhatia	4753A	G. Ram
4262A	Nand Kishore Upadhya	4770A	R. N. Goel
4285A	P. D. Kaushik	4778A	P. K. Uppal
4286A	S. P. Chowdhury	4779A	Avtar Singh
4287A	N. Kumar	4796A	Raj Kumar
4314A	Tilak Raj	4806A	O. P. Dhall
4334A	S. C. Jain	4809A	H. Kumar
4339A	Virendra Nath	4810A	Narinder Mohan
4345A	M. L. Pahuja	4823A	D. K. Puri
4348A	Indra Raj Chawla	4838A	Shiv Lal Lakhani
4365A	Baldev Krishen Verma	4841A	M. S. Rijhumal
4389A	Om Parkash	4846A	M. M. Parashar
4390A	Jogdish Chander Nagpal	4887A	Amrit Lal Gupta
4394A	O. P. Khurana	4910A	R. K. Goel
4395A	Kuldip Singh Narula	4974A	Gurcharan Singh Panesar
4396A	K. L. Malhotra	5017A	C. K. Roy
4412A	R. K. Arora	5123A	Virendra Mohan
4415A	A. K. Dewan	5149A	Manik Chand
4430A	Hira Lal	5187A	L. S. Bhatnagar
4450A	Ajit Pal Singh Virdi	5217A	J. Lal Sharma
4474A	S. C. Jandwani	5222A	Ram Bir Singh
4477A	K. Krishan	5242A	Sushil Kumar Nagpaul
4491A	Subhash Chandra Dua	5353A	O. P. Narang
4492A	Lekh Raj Vohra	5391A	Rajender Kumar
4496A	Bachan Lal Kalra	5422A	Sudarshan Kumar
4497A	N. K. Vijra	5445A	M. Gupta
4509A	Hari Krishan Agrawal	5502A	Surinder Singh Bhatia
4519A	H. C. Gupta	5508A	Prahlad Singh Varma
4530A	Ram Prakash	5549A	Baldev Raj Oberoi
4543A	Surendra Kumar Jain	5553A	Nanak Chand
4561A	R. Singh	5566A	Satish Kumar Chopra
4567A	G. N. Rao Karhadkar	5583A	B. S. Khalsa
4579A	M. C. Gulati	5610A	Prasanta Sen Gupta
4590A	Brijmohan Lal	5656A	Gopeswar Mandal
4592A	Mahesh Chandra Gupta	5657A	Jyotirmoy Banerjee
4593A	Jai Kishan Singal	5679A	N. K. Choudhury
4636A	Jai Prakash Mittal	5740A	P. K. Chakrabarti
4643A	P. S. Dahiya	5748A	M. M. Dutta
4648A	Gurcharan Singh Chadda	5751A	J. P. Datta
4676A	Sarvadanand Pathak	5759A	S. Das
4680A	J. C. Malhotra	5793A	Arup Kumar Ganguly
4683A	Charanjit Singh	5806A	T. K. Roy Chowdhury
4692A	Satinder Pal Singh	5814A	Gurcharan Singh Chawla
4693A	Vishwa Mitter	5843A	Kirshan Kumar Goel
4695A	Ujagar Singh Bhatia	5849A	Rebati Nath Das
4702A	Desh Kumar Vijh	5873A	P. K. Sarkar
4706A	B. R. P. Singh	5890A	S. Bandyopadhyay
4726A	Mahendra Singh	5893A	Sushil Kumar Kundu
4729A	Om Parkash Bhandari	5896A	Ranjit Kumar Karmakar

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A—*contd.*

Roll No.	Name of candidate
5912A	Kartik Chakravorti
5913A	Ranes Patranobis
5929A	Dhirendra Nath Pal
5962A	S. B. Prasad
5964A	Asok Kumar Ghosh
5973A	Basudeb Ray
6005A	M. P. Manoharachandran
6010A	N. K. Shanbhaj
6026A	L. V. Jalihal
6043A	R. S. Murthy
6067A	N. S. L. S. Rao
6080A	E. Jayanth
6091A	Dhirendra Nath Dass
6102A	M. R. K. Rao
6107A	Nandivada Prabhatam
6159A	R. K. Dev
6188A	P. S. Murty
6195A	Ajit Singh
6207A	K. Veera Anjaneyulu
6213A	A. C. Sekharareddy
6222A	Methuku Komaraiah
6234A	Ponnam Ellaiah
6294A	M. V. Deshpande
6307A	G. C. Betala
6340A	Man Mohan Mohanty
6346A	R. Ramabrahmanadam
6350A	Thellapalli Venkateswarlu
6395A	Sirangam Vittal Rao
6438A	Cheeti Damodhar Rao
6458A	C. N. Rao
6468A	Md. Badruddin Khan Sayeed
6501A	C. A. R. Somayajulu
6540A	Tirumuru Venugopala Reddi
6573A	M. T. Shamdasani
6586A	Hira Lal Sahu
6589A	Utpal Das
6590A	S. K. Misra
6601A	Kanhaiya Lal Kannogia
6609A	Vasant Mahadeo Bakshi
6611A	A. Venugopal
6622A	Naresh Kumar Sharma
6628A	Vinod Kumar Lamba
6636A	Lashkar Singh
6646A	Gajrai Singh
6683A	Narendra Singh
6700A	C. Kanayalal Bhatia
6713A	B. R. Suhnani
6728A	Desh Raj Nagpal
6741A	Mohan Lal Tandan
6750A	Satya Narain Gupta
6782A	V. B. K. Suri
6787A	S. K. Sharma
6788A	L. O. Gulechha
6790A	Govind Sharan Mathur
6791A	Suresh Chandra Gautam
6794A	Amolak Chand Ankodia
6798A	Mohan Lal
6804A	A. Srinivasan
6822A	Rajendra Singh
6823A	Som Prakash Agarwal
6834A	V. P. Sharma
6853A	Maharaj Parshad Agarwal
6895A	Shanker Lal Sharma
6908A	Lal Kishan Sharma
6931A	Mohan Singh Verma
6932A	Vinay Kumar Verma
6950A	P. R. Sharma
6961A	M. S. Sarwari
6984A	S. R. Singh
6989A	Krishan Murari Pareek
7073A	Basitullah Khan
7139A	Dewat Ram Jakhal
7149A	G. N. Sahay
7230A	A. Prakash
7239A	K. S. Rao
7243A	Jai Krishan Sharma
7252A	P. V. Krishnan
7279A	Prem Singh Kachhwala
7280A	B. M. Vijaiveragia
7282A	Pradeep Singh Trahun
7310A	Jai Roop Chand Mathur
7350A	Gulshan Rai Kukar
7369A	M. C. Mehta
7463A	Bhagwan Das Daga
7469A	R. P. Chakraborti
7532A	Om Prakash Satpute
7553A	Sohan Lal Sharma
7578A	Ram Niwas Rai
7579A	P. K. Shrivastava
7588A	Gopal Prakash Jauhari
7594A	Om Prakash Agarwal
7596A	G. K. Mehta
7626A	B. N. Bhargava
7642A	Yashoda Nand Dubey
7651A	Nand Lal
7652A	M. L. Khurana
7655A	Naresh Kumar Asija
7656A	Kuldip Singh Rehill
7657A	D. Chandra
7665A	S. N. Singh
7666A	Hari Datt Pande
7746A	Hari Krishna Singhal

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A—*contd.*

Roll No.	Name of candidate
7761A	A. K. Gupta
7777A	Ram Kumar Gupta
7791A	Jai Lal Pamnani
7794A	Girish Babu Saxena
7804A	Choudhary Veer Kumar
7805A	Krishan Kumar Mehta
7806A	Prem Chandra
7818A	R. N. Agrawal
7846A	Ram Krishna Dikshit
7869A	S. K. Sakhuja
7870A	V D. Keswani
7893A	Babban Singh
7900A	Jagdish Prasad Gupta
7907A	K. S. Venkataramani
7923A	O. P. Srivastava
7937A	Kishori Lal Kashyap
7959A	S. C. Khurana
8000A	R. S. Gupta
8040A	Prem Sagar Misra
8052A	Daya Shankar Chaturvedi
8082A	D. C. Saxena
8092A	Devbrat Bhattacharya
8108A	K. C. Gupta
8171A	Sheo Pal Singh
8224A	Rajendra Kumar
8228A	S. Shukla
8230A	Mohammad Voli
8268A	Kalpnath Rai Sharma
8284A	Satish Chandra Dikshit
8354A	P. Singh
8356A	Jagdish Chander Sodhi
8375A	S. K. Sethi
8381A	Mahan Bir Kathpal
8432A	Narata Ram
8433A	Uma Kant Kutwal
8440A	H. S. Sandhu
8444A	S. Singh
8462A	Vinod Chander Mohindra
8471A	Takhat Singh
8473A	Harnek Singh
8503A	D. K. Bhalla
8514A	H. S. Ranu
8544A	Vinod Kumar Malhotra
8563A	Mohan Singh
8565A	Harinder Pal Puri
8597A	H. S. Dhaliwal
8598A	P. S. Matharu
8622A	Amrit Lal Mittal
8634A	J. K. Prusty
8635A	B. P. Bahalia
8636A	K. Ramamurthi
8637A	K. Venkateswaran
8639A	Marappagounder Karuppanna
8654A	Venugopal Balakrishnan
8668A	Fateh Singh Khatri
8682A	T. Sambandan
8693A	B. Sahoo
8694A	Satyabadi Nanda
8721A	K. C. Mohapatra
8730A	Narne Ramamurty
8760A	Gaya Prasad
8791A	G. Govindan
8798A	M. Krishnamoorthy
8819A	K. Ravindranath
8826A	P. S. Arun
8871A	N. Narayanan
8910A	P. Sethumadhavan
8928A	M. S. Rao
8934A	T. Chelladurai
8940A	U. Veeraraghavulu
8948A	N. S. Apparaj
8960A	H. Thyampanna Naik
8989A	V. N. Iyer Rajan
9069A	K. T. George
9082A	K. Ramachandra Udupa
9083A	A. M. Ali Faruk
9093A	Surendra Singh
9094A	Ramdas Pande
9098A	D. Srinivasamurthy
9101A	Vishwa Nath Verma
9105A	Rangaswamy Krishna
9109A	K. N. Viswanath
9113A	M. R. Subbakrishna
9129A	Krishnaiyer Viswanathan
9135A	D. Kumara
9137A	Munisamappa Chandrappa
9143A	P. Narasimha Bhat
9148A	M. A. S. Kumar
9151A	S. G. Gunavaram
9154A	Suryanarayana Ramesh
9165A	N. Sreenivasa Moorthy
9208A	J. Lal
9219A	G. M. Dhandole
9239A	Hazur Singh Dhariwal
9244A	T. V. Warhekar
9287A	Madhukar Kondbarao Wagh
9334A	P. Subramaniyan
9342A	K. Gopalaiah
9344A	G. V. Kannan
9359A	C. S. Vaithianathan
9367A	R. Kumarasamy

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A—*contd.*

Roll No.	Name of candidate
9372A	K. Kannan
9385A	V. Venkataramani
9443A	Muthuswamy Subramanian
9446A	Raghavachary Thiruvenkata
9447A	P. Venkateswara
9454A	P. R. Seshadri
9456A	S. Nagasubramanian
9481A	P. S. Satyanarayanan
9482A	Raghavachari Chandran
9483A	K. Balakrishnan
9486A	S. Krishnamurthy
9492A	S. Nagarajan
9513A	Devki Nandan Gaur
9528A	Mani Ram Gurera
9555A	Harinder Singh Paul
9562A	Sukhinder Singh
9565A	Narinder Singh Walia
9580A	Shyam Sunder Suri
9619A	Baldev Krishan
9620A	P. D. Mahajan
9636A	Krishan Gopal Gupta
9640A	V. P. Goyal
9657A	Ravindra Kumar Bajaj
9690A	Ram Gopal Tathgir
9702A	O. P. Sondhi
9710A	Mohan Lal Gupta
9729A	Shiv Kumar Uppal
9730A	Metab Singh
9750A	Ram Kishan Garg
9755A	S. C. Chhabra
9760A	Vidya Sagar
9809A	B. S. Chawla
9843A	Balmiki Prasad Singh
9894A	Deo Narayan Bhagat
9908A	T. P. Sinha
9942A	Ghanshyam Lal Shah
9949A	V. C. Singh
9983A	D. M. Panditrao
9991A	B. V. Chaudhari
9993A	Aravind Vinayak Ghone
10002A	P. Venugopalan
10009A	Khema Ziparu Chaudhari
10010A	Ganapati Shankar Kabade
10059A	S. B. Dattawadkar
10067A	Sharad Hari Vaidya
10068A	Vasudeo Hanmant Kulkarni
10081A	P. T. Pawar
10084A	R. D. Ratnaparkhi
10113A	Sham Sadashiv Gore
10125A	K. G. Shetty
10128A	S. P. Bhandari
10129A	S. R. Halbe
10170A	S. D. Joshi
10190A	B. G. Kulkarni
10204A	Vasant Khando Kulkarni
10211A	V. Sitaram Gajare
10214A	C. T. Nerlekar
10226A	C. M. Mathai
10252A	Ant Anna Patil
10266A	J. W. Pore
10284A	B. D. Deshpande
10291A	S. K. Nargunde
10308A	V. A. Konkar
10312A	C. B. Katakkar
10327A	Nanak Chand Haswani
10344A	H. Chakraborty
10352A	Chander Bhan Sharma
10355A	G. Ananthakarishnan Nair
10442A	B. B. P. Teterbai
10448A	Hazara Singh Malhotra
10467A	Bhagwan Dass
10471A	Vijay Kumar Soni
10473A	Bal Bhadra Singh
10474A	Raj Kumar Gupta
10476A	Prem Prakash Bhola
10509A	Chander Bhan
10516A	Sudershan Kumar Gupta
10525A	M. D. Mittal
10548A	P. Chandra
10562A	D. K. Rajbansi
10577A	Badan Singh
10595A	Shiam Sundar Lal
10623A	Prem Chandra Srivastava
10654A	Rabindra Nath Gupta
10698A	Radhey Shyam Verma
10713A	B. Maharana
10726A	Bhola Nath Pusti
10735A	Ch Narasimha Rao
10751A	K. C. Panda
10755A	Ram Gopal
10766A	Kedar Nath Pareek
10814A	B. P. Kapur
10822A	S. K. Bandyopadhyay
10824A	Ram Adhar Singh
10858A	M. A. Ghazi
10861A	Hardev Singh
10906A	Hira Lal Magazine
10926A	N. Ramanathan
10956A	R. Varghese
10960A	Harihara Kulathu Iyer
10976A	I P. Ravi
10981A	K. N. Kunjunni Kartha

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A—*contd.*

Roll No.	Name of candidate
10982A	P. R. Kamalan
11047A	K. G. Rajappan
11057A	N. G. Pillai
11080A	G. S. Belachandran

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B

Civil Engineering

Roll No.	Name of candidate
36B	V. Venkatasamy
41B	Jawharlal Damumal Khatri
77B	N. Ananthapadmana Rao
91B	G. Subrahmannya Sastry
118B	A. V. Ramamurthy
140B	S. N. Chakraborty
148B	Janardan Krishna Jadhav
150B	Ram Nandan Sharma
184B	S. N. Barde
186B	Subodh Chatterjee
187B	Bhagwan Thakurdas Bajaj
209B	Navin Chandra Bhatia
211B	A. B. Phadke
214B	Gudibanda Neelakanta Rao
220B	A. A. Prabhu
229B	D. B. Patel
243B	S. K. Paul
258B	Janmejay Mohapatra
264B	Shashthi Charan Roy
332B	Priyaranjan Sengupta
348B	Jayanta Kumar Sengupta
356B	Harbans Lal Handa
375B	S. R. K. Aggarwal
393B	K. Singh
400B	Atam Prakash Mahajan
401B	Gurjanak Singh Soin
420B	G. Mohanty
424B	Nityananda Mohanty
448B	A. C. Sahoo
449B	H. Khandual
452B	Rabindranath Nayak
460B	P. Sahu
463B	Kunjabihari Mahapatra
464B	Suryanarayana Ratha
466B	Nabakishora Nanda
469B	Basanta Kumar Tripathi
499B	Jeshth Nand Madan
509B	Kimat Lal Anand
515B	Satya Narayan
523B	M. S. Verma
530B	Surinder Kumar Khanna
541B	Mahesh Chander Dhawan
556B	Surinder Kumar
572B	Prem Nath Seth
580B	Sushil Kumar Bhatia
594B	Amar Chand Jain
596B	Narendra Kumar Jain
607B	Amrik Singh Parmar
639B	Sarwan Kumar
664B	G. L. Mittal
671B	Dilbagh Singh
675B	Inder Kumar Malhotra
714B	Rajendra Kumar
715B	C. M. Aggarwal
725B	G. L. Bhasin
734B	Satish Chander Sawhney
742B	K. S. Gangal
746B	T. G. Purushothaman
762B	Hemanta Kumar Chakravarti
766B	Dilip Kumar Roychowdhury
817B	S. M. Saheb
839B	V. C. Mutyala Rao
856B	K. M. Setty
859B	Didla John Bhaskar
861B	Arra Narasaiah
875B	Bommana Krishnamurthy
903B	Baban Nagnathrao Kamble
916B	M. U. Rao
919B	S. Thiagarajan
935B	Ram Autar Dubey
949B	H. Singh
967B	R. Singh
970B	S. Kumar
986B	S. J. Sahasrabudhe
1008B	Mahesh Chandra Mathur
1052B	S. C. Verma
1068B	R. M. Agarwala
1154B	J. S. Grewal
1165B	S. Loganathan
1171B	S. D. Khepar
1194B	P. Eswaramoorthy
1197B	Mahendra Mohan Goswami
1204B	T. Periasamy
1211B	N. A. Nair
1224B	S. Krishnamurthy
1231B	V. S. Rama Chandra Murthy
1234B	V. S. Rajeswaran

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B—*contd.*

Roll No.	Name of candidate
1237B	Kannaih Srinivasan
1238B	K. Ananthanarayanan
1252B	M. S. N. Murthy
1272B	S. P. Lampuse
1274B	Bapurao Shravan Kene
1278B	Sarindar Kumar Bhugra
1282B	V. P. Sharma
1284B	S. Vaithiyanathan
1290B	P. Anantharama Gangadharan
1292B	K. Narasimhan
1301B	Des Raj
1317B	Manmohan Singh
1318B	D. S. Chaudhry
1344B	Ramji Lal Shrivastav
1355B	Sita Ram Prasad
1376B	Rajeshwar Mishra
1378B	A. D. P. Singh
1386B	Padmakar Yeshwant Sathe
1388B	Digamber Deoram Shinde
1400B	P. S. Chitale
1409B	P. V. Pathak
1410B	B. V. Kolhatkar
1415B	S. C. Nath
1427B	S. N. Inamdar
1440B	R. V. Jawadekar
1442B	Dattatraya Hari. Karmarkar
1448B	M. Kumar
1451B	Diwakar Jha
1453B	Kantiprakash Mukhopadhaya
1454B	S. K. Kanjilal
1458B	Jagdish Kishore Misra
1459B	S. P. Sinha
1463B	R. C. Bansal
1486B	D. Prakash
1510B	S. K. Chowdhury
1512B	Nalini Kanta Misra
1514B	B. C. Samal
1538B	B. L. Kaul
1543B	P. Sivasankara Pillai
1547B	I. Pathrose
1567B	P. K. B. K. Nair
1569B	R. Venkitachalam
1577B	T. P. Thomas
1605B	N. K. Murthi

Mechanical Engineering

Roll No	Name of candidate
1634B	O. P. Bindra
1664B	P. S. Rao
1674B	V. K. Ravindran
1675B	N. S. Sathyanarayan
1678B	P. Damodara
1694B	C. Lakshmikantaiah
1702B	K. K. Kamath
1706B	M. Venkataraman
1715B	B. V. S. Jagannatha
1732B	P. Balakrishna Shenoy
1735B	A. Selvaraj
1741B	C. S. Santhanam
1742B	S. Lakshminarayan
1746B	P. G. Reddy
1747B	Rajgopala Ramakrishnan
1781B	J. S. S. Sagoo
1783B	N. Santhanam
1786B	M. L. Puri
1795B	S. S. Patel
1807B	K. S. Arunachalam
1814B	R. K. Sharma
1818B	T. K. Srinivasan
1820B	A. S. Gogia
1839B	V. Desapathi
1841B	S. N. Agarwal
1854B	Sanat Kumar Jain
1855B	Ranvir Singh Yadav
1861B	M. S. Nadar
1897B	D. K. Korgaonker
1921B	P. F. Doshi
1927B	M. P. Vegad
1938B	S. P. Das
1967B	V. K. Rao
1992B	S. N. Nath
1994B	S. Bhattacharyya
2035B	S. Sarkar
2086B	B. M. Ganguly
2089B	Arun Kumar Ghosh
2096B	S. K. Das
2108B	Prosanto Kumar Basu
2112B	R. K. Sharma
2123B	U. De
2126B	Malay Ranjan Ghosh
2146B	A. K. Mohan
2153B	H. N. Gakhar
2157B	V. P. Kheterpal
2166B	K. V. K. Shastry
2173B	Shaikh Fakiruddin
2175B	S. K. Madan
2178B	Madan Gopal Alagh
2188B	Darshan Lal Rewri
2199B	V. R. Chopra
2204B	Mohinder Singh Saberwal
2205B	P. K. Gupta
2208B	Prem Parkash Khanna

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B—*contd*

Roll No.	Name of candidate
2216B	Raj Pal
2219B	Karam Jit Singh Rudra
2246B	D. N. Rawal
2250B	M. L. Uttamchandani
2255B	Sudhir Gajbhiye
2265B	Nirmal Singh
2275B	Ravindra Verma
2280B	M. K. Chowdhuri
2286B	Deba Prasad Ray Chaudhuri
2299B	P. R. Reddi
2300B	Sivalenka Dakshina Murty
2301B	K. Rajaveeru
2312B	A. S. Murty
2329B	V. D. V. S. Krishnarao
2331B	K. S. Dikshitulu
2332B	H. M. A. Khiyam
2334B	Govind Ram Modi
2352B	A. G. Petkar
2361B	D. Mallikarjuna Rao
2362B	B. Pasupathi Ram
2398B	K. D. Saxena
2401B	Mohindar Singh
2409B	J. S. Sidhu
2425B	Gokul Singh
2434B	R. Singh
2454B	Arunachalam Hariharan
2455B	Nanasaheb Bhau Patil
2464B	Manohar Lal Sharma
2472B	Narendra Kumar Mittal
2473B	H. Kalumal
2475B	B. L. Lohar
2509B	B. Subramanian
2516B	Satya Narain Tandon
2521B	Prayag Chand Singhvi
2527B	Ananda Mohan Mukhopadhyay
2530B	Sita Ram Agrawal
2536B	Alam Chand Biswas
2553B	B. Ramakrishnan
2565B	R. Subramanian
2566B	A. Somasundaram
2570B	S. G. Subramanian
2586B	S. B. Venkatesan
2592B	M. M. Balasubramanian
2612B	P. M. Rajagopalan
2614B	S. R. Krishnan
2630B	B. K. Shankara
2634B	R. S. K. Murthy
2637B	T. G. Sharma
2638B	K. A. Murthy
2644B	Nagamanickam Srinivasan

Roll No.	Name of candidate
2645B	John Thomas
2647B	R. A. Gnaniar
2652B	B S. Sudhakara Rao
2653B	G. Gurumurthy
2654B	B. Venkata Subba Rao
2667B	S. C. Agarwal
2668B	K. Singh
2669B	V. K. Manchanda
2683B	Mukund Damodar Dharap
2690B	K. Basu Roychaudhuri
2714B	B. Gangadhar Sane
2716B	Yanamandra Krishna Murthy
2727B	S. N. Prasad
2739B	Rattan Dev Khajuria
2765B	D. P. Agrawal
2767B	Bhawani Prasad
2773B	K. Parameswaran Pillai
2778B	K. J. Chacko

Electrical Engineering

Roll No.	Name of candidate
2811B	G. Aggarwal
2812B	S. R. Jawlekar
2813B	K. B. Tahilram
2828B	Baglody Shridhara Rao
2832B	V. Krishnamurthy
2835B	V. Satya Bodha Rao
2837B	B. G. Raja Rao
2842B	H. S. Bhatti
2860B	R. C. Gupta
2887B	Vasant Madhwarao Naik
2911B	Sham Lal
2914B	S. J. Rao
2924B	K. K. Saxena
2938B	B. R. K. Datar
2941B	R. N. Rath
2960B	B. U. Wagle
2967B	G. D. Ram
2981B	M. L. Sharda
2982B	A. C. Saxena
3000B	Belle Deva Rao
3010B	N. R. Balasubramanian
3011B	Mukund Vasudeo Joshi
3013B	P. V. Balani
3030B	Anoop Singh Wadhwa
3031B	K. B. Makihatana
3037B	M. M. Shaikh
3057B	R. K. Singh
3059B	S. Chatterjee
3078B	K. S. Pillai
3082B	K. K. Haldar

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B—*contd.*

Roll No.	Name of candidate
3083B	Phatik Lal Das
3104B	M. Mukhopadhyay
3113B	A. R. I. Mrithyunjayan
3122B	Surajit Kumar Sen Gupta
3124B	Shiv Kumar Jhunjhunwala
3141B	Pyara Lal
3142B	Amrit Lal Saini
3159B	Daljit Singh Gill
3168B	Bishnu Charan Sahoo
3176B	V. Behari
3179B	G. S. Matharu
3183B	A. Singh
3194B	Parkash Chand Snehi
3216B	M. S. Negi
3222B	Mohan Kisharam Java
3241B	Mahaveer Prasad Mittal
3258B	B. N. Ahuja
3261B	Ram Niwas Sharma
3274B	Rameshwar Nath
3285B	Arun Kumar Goswami
3301B	S. P. Malhotra
3310B	Jinka Subbarayudu
3311B	K. Gajapathy
3313B	Aruru Paramasivachari
3327B	P. V. R. M. Sarma
3332B	Bedathala Akki Reddy
3339B	G. K. Srinivas
3347B	Sistla Sivaprasad
3349B	S. P. Mishra
3354B	V. Paulose
3363B	P. C. Sukumar
3366B	Suresh Chandra Saxena
3413B	K. S. Virdi
3418B	Harish Chander Dhanda
3429B	S. M. Yadav
3451B	M. Peddaiah
3454B	Putta Rama Rao
3458B	V. Gnanasambandam
3465B	M. Navasingh
3466B	T. M. Raghunathan
3494B	C. R. Baskaran
3499B	O. Bala Obula Reddy
3510B	J. S. Rahi
3524B	Ramesh Chander Bhatia
3525B	Dilip Kumar Chatterjee
3532B	Rudra Narain Anand
3535B	Mohanlal Rajaram Rajput
3575B	G. S. Sarma
3576B	M. S. Quraishi
3577B	S. S. Mukerjee
3578B	R. P. Singh
3580B	G. S. Bharara
3586B	Sivaraman Bhoothalingom
3591B	J. Ratnaraj
3597B	V. G. Nair

Chemical Engineering

Roll No.	Name of candidate
3619B	V. D. Rawtani
3632B	Jagdish Chandra Pasrija
3645B	G. Sambamurthy

Mining Engineering

Roll No.	Name of candidate
3660B	Durga Shanker Nagda

Metallurgical Engineering

Roll No.	Name of candidate
3666B	A. P. Chaba
3669B	Kuljit Singh
3674B	P. Datta
3676B	B. K. Ray
3680B	T. K. Basu
3684B	K. N. Baral
3703B	T. K. Ray
3706B	Bishnu Pada Sen
3710B	Bhabapriya Aich Bhowmick

Electronics and Telecommunication Engineering Division

Roll No.	Name of candidate
3725B	T. S. Lamba
3726B	Ram Niwas
3735B	Meloth Kumaran Nambyar
3749B	P. C. Das
3755B	R. P. Mohindra
3759B	Chatar Singh
3764B	Dwarka Nath
3767B	Miss K. Saroja
3770B	P. K. Pal

PERSONALS

Shri A. VENKATESWARA RAO, B.E. A.M.I.E., has been awarded a Prize of Rs. 1,000 on Republic Day this year. Shri Rao has developed a new method of prestressing of concrete which he has named 'Avro system'. The importance of Shri Rao's method lies in combining the prevailing two systems of prestressing, namely, post-tensioning and pretensioning, and thus eliminating the defects inherent in both the systems to produce a unified, advantageous system. The technical know-how and the equipment required for prestressing were hitherto imported from foreign countries. The invention of Shri Rao will do away with this foreign dependence in the matter of technical know-how and equipment, as his system is based on the use of indigenous jigs and gadgets. When the system is implemented on a large scale for the manufacture of electric poles, components for prefabricated buildings and railway sleepers, there will be considerable saving on the cost of production. The invention has already been put to use in the Andhra Pradesh State Electricity Board and has yielded good results.

BOOK ACKNOWLEDGMENTS

1. **Hydraulics and Hydraulic Machinery.** M. Kothandaraman. *Orient Longmans Ltd.*, Rs. 10, 1966, 331 pages.

In this book, written in M.K.S. units, each chapter contains problems with solutions, and the formulae and principles involved in solving them. Problems with intricate structures have been chosen and solved from first principles to train the students to face all types of questions.

2. **Applied Mechanics—vol. 1.** J. C. Mehta. *New Asian Publishers*, Delhi, Rs. 10, 1966, 368 pages.

In this book, written in M.K.S. units, the necessary theory is given in every chapter, together with typical solved examples and selected questions from various universities, institutions and State Boards. One new chapter on 'Moment Inertia' has been included and the chapter on 'Simple Mensuration' deleted.

3. **Hydraulics of Stable Channels.** S. V. Chitale. Published by the Central Water and Power Research Station, Poona, Rs. 38.50, 1966, 395 pages.

This is an exhaustive review compiled after a detailed study of more than five hundred publications and extraction of necessary information by a sub-committee appointed by the Central Board of Irrigation and Power. This book was later entrusted to the Central Water and Power Research Station, Poona. Latest developments in this field have been incorporated in this publication.

4. **The Gas Industry Today and Tomorrow.** L. T. Minchin. *George G. Harrap & Co. Ltd.*, 25s. 1966, 180 pages.

In this book the gas industry is surveyed in world perspective. The pattern of organization of the gas supply industry in several countries—including the U.K., the U.S.A. and the U.S.S.R.—has been described in one chapter. Another chapter is devoted to the new method of carrying gas by special sea-going tankers capable of carrying liquefied gas at very low temperatures. The new methods of de-toxifying town gas, everyday practicalities, and uses of gas are also discussed in this book.

5. **Factory Management and Business Organisation.** A. S. Deshpande. *Vora & Co., Publishers Private Ltd.*, Bombay, Rs. 11, 1966, 520 pages.

The fundamental principles of management are given in the first portion of this book. Production management is dealt with subsequently. Factory and labour laws, and business organization and finance are discussed in the later portion of the book.

6. **Guide to Design Criteria for Metal Compression Members.** B. G Johnston (*ed.*). *John Wiley & Sons, Inc.*, $10.00 2nd edition, 1966, 217 pages.

In this second edition, the original five chapters have been thoroughly revised and brought up-to-date, with new material on the effects of residual stress and initial curvature, and on the strength of tubular columns. A chapter on plate girders and one on compression chords of pony trusses have been added. Many new references are given in this edition.

7. **Machine Design.** Prof. S. C. Bhattacharyya and J R Basu Mallik *Basu Mallik & Co.*, Calcutta, Rs 22 50, 1966, 969 pages.

The topic of machine has been precisely dealt with in this book enabling the student to design simple machines after studying the book Formulae, mechanical processes, properties of materials have been included in this book. The subject matter in the book has been dealt in both the F.P.S. and the metric systems.

8. **Electromechanical Power Conversion.** E. Levi and M. Panzer. *McGraw-Hill Book Co. Inc.*, 1966, 499 pages.

This text presents a unified treatment of its subject matter in terms of the interaction between electromagnetic fields and ionoized matter. The integrated treatment of particle motion, plasmas and practical devices has never before appeared in a book for students. Part of the material has been collected from recent scientific periodicals. Examples and problems chosen to clarify the application of basic principles to situations of interest have been included. This book stresses physics and synthesis rather than sophisticated network analytical techniques.

9. **Applied Electricity.** A. W. Hirst. *Blackie and Son Ltd*, 4th edition, 1966, 55s, 439 pages.

In this fourth edition of a book, the transition from C.G.S. to M.K.S. units has been effected and a table given to compare the two systems. The text has been reset and revised. Considerable new material has been added to the chapters on 'D.C. Machines', 'A.C. Circuits', 'Transmission and Distribution', 'Instruments and Measurements' and 'Materials', and the chapter on 'Electronics' has been omitted.

10. **Mechanical Behaviour of Materials.** F. A. McClintock and A. S. Argon. *Addison-Wesley Publishing Co., Inc.*, $17.50, 1966, 770 pages.

In this book, emphasis is laid on mechanical behaviour from the standpoint of structural, mechanical, marine and aerospace engineering. The text, though meant for degree students of engineering, can also serve as a reference source for professional engineer. About five hundred problems are provided, fifty of which are designed around experiments involving simple materials. Information sources are included together with a materials index.

11. **Technical Reference Book on Valves for the Control of Fluids.** The British Valve Manufacturers' Association, London, 1966, 342 pages.

The aim of this publication has been to provide information that will be of positive value to users of valves in all parts of the world. Complete sets of tables of face-to-face dimensions, pipe threads, and pressure-temperature ratings have been given in this book.

12. **Structural Concrete. K. F. Antia.** *The New Book Co. P. Ltd.*, Bombay, Rs. 35, 1967, 572 pages.

The title, Structural Concrete, has been adopted to cover the fundamentals of design, technology and construction of plain, reinforced and prestressed concrete. The metric system of weights and measures has been adopted and Indian Standard Codes and Specifications have been applied, reference being made also to British and American Codes where relevant. The book is divided into seven sections. The first section deals with the Fundamentals and basis of design. The Working stress method of design is given in Section 2 and the Load factor method in Section 3. Section 4 gives the method of design of Buildings and Structures whilst the remaining three sections are devoted to Indeterminate structures, Prestressed concrete, and Concrete construction and repairs. An attempt has been made to explain the essentials of the theory and design of each aspect of the subject. In addition, designs have been given of as many types of structures as possible and these have been extensively illustrated with examples. The designs have been grouped under .1 Buildings, .2 Industrial structures and .3 Civil engineering structures. Four chapters have therefore been devoted to concrete technology and concrete construction procedures including concrete mix design.

PUBLICATIONS RECEIVED

A copy of the 'Annual Report 1964-65' of the National Metallurgical Laboratory, Jamshedpur, has been received. Short reports of research conducted at the laboratory, processes released to the industry, and the various works undertaken have been mentioned in this publication.

An Educational Catalog from Soil Test, Inc., Illinois has been received. This catalog gives a list of some of the instruments used for testing of soils and their uses.

A copy of the 'Annual Report 1965' of the International Institute for Land Reclamation and Improvement, Netherlands, has been received. The report gives a sketch of the 'International Hydrological Decade and Land Development' and a summary of the activities of the institute.

A copy of the 'Annual Report for 1966' of the Indian National Group of the International Association for Bridge and Structural Engineering, New Delhi, has been received. The report includes notes on bridges and other structural engineering works and a paper on 'Construction of High Level Bridge across River Mahanadi on N.H. No. 5 at Cuttack'.

A copy of the 'Annual Report of the Civil Engineering Laboratories for 1965' of the University of Roorkee has been received. The publication gives a list of staff of the civil engineering department and a list of publications by staff and a list of reports of the activities of the Hydraulics, Soil Mechanics and Foundation Engineering, Highway Engineering and Structural Engineering.

A copy of the 'Annual Report for 1965' of the Central Building Research Institute, Roorkee, has been received. The report covers the research conducted in the fields of building materials, soil engineering, efficiency of buildings, building processes, plant and productivity, and architecture. Notes on information and survey, extension, administration, etc., are also given.

A copy of 'Sewer Maintenance', has been received from the Water Pollution Control Federation, Washington, U.S.A. The manual has been much revised after it was first published in 1960. It presents detailed coverage of the need for maintenance ; basic policies ; maintenance organization for large, medium, and small cities and towns ; records and permits ; equipment ; preventive sewer maintenance ; minor sewer repairs ; wastewater pumping stations ; safety measures, public relations and design considerations.

A copy of the 'Annual Report 1965-66' of the School of Research and Training in Earthquake Engineering of the University of Roorkee has been received here. The progress of the research work conducted is given in this publication. Methods of strengthening brick buildings worked out, laboratory instruments designed and manufactured in the school, observation work of the structural response recorder stations have been continued, and research work carried out in structural dynamics and soil dynamics with wide applications—these are some of the problems pursued and worked out at the school.

The first issue of vol. 1 of the 'Computer Centre Bulletin' has been received from the Structural Engineering Research Centre, Roorkee. The bulletins will feature utility programmes developed at the Centre. The programme now available with the Centre relate to the analyses of a wide variety of structural systems such as prestressed concrete beams, plates, shells, folded plates, complex girders, multistoreyed structures, and space frames.

This pamphlet on 'Metalworking' brought out by Diamond Information Bureau has been received. It deals with qualities of diamond tools and their applications.

The publication titled 'Concrete Block Walls' brought out by the Cement and Concrete Association, London, has been received. It explains the methods of manufacture of concrete block walls and their uses. The description of facing blocks as also the design of facing blockwork and the building facing blockwork and the painting of facing blockwork are also given in this publication.

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here.

Shri J. J. Patel

Shri Jashbhai Jinabhai Patel, B.E., M.I.E., died on March 14, 1967, at the age of 65. He was a Life Member of the Institution.

Born at Sojitra, Kaira District, Shri Patel obtained his B.E. degree in Civil Engineering from the University of Bombay in 1925. After serving for short periods as Instructor in the College of Engineering, Poona, in the

Drawing Office of Power Co. Ltd., Bombay, on construction work in the then B.B. & C.I. Railways, Bombay, and in the preparation of project reports for minor irrigation and water supply works for Dakot, Gujarat, under the Government of Bombay, he took up permanent employment as Engineer in the District Local Board, Surat, in 1928. He worked in various positions in the P.W.D. of Bombay State and retired as Executive Engineer in 1957. In 1957 he joined the Central Office of the Life Insurance Corporation of India as Executive Engineer and in the following year joined as Branch Manager of Garlick & Co. Private Ltd. In 1962 he was appointed Additional Town Planning Officer in the Government of Gujarat State.

Shri Patel joined the Institution as Associate Member in 1943 and was transferred to Member in 1963.

Shri G. Senapaty

Shri Gouranga Senapati, B.Sc., A.M.I.E., Mechanical Chief Engineer, Orient Paper Mills Ltd., Brajrajnagar, had a fatal fall on March 2, 1967 from a height of about 80-90 ft.

Born at Guapur, Puri, in 1930 Shri Senapaty passed the I.Sc. examination from the Utkal University in 1948, and obtained his B.Sc. (Eng.) degree in both Electrical and Mechanical Engineering from the Benaras Hindu University in 1952. He had his apprenticeship training in the Calcutta Tramways Co., Ltd., for six months and was employed as Assistant Engineer in the Orient Paper Mills, Brajrajnagar, for about 5 years. In 1957 he went to West Germany for higher training for a year. He was then appointed as Mechanical Engineer in the Belpahar Refractories Ltd. where he was responsible for the erection of machinery for production of refractories. He had also installed the water supply system for a part of the workshop.

Prior to his appointment as Mechanical Chief Engineer in the Orient Paper Mills Ltd., Brajrajnagar, Shri Senapaty also served in the Titaghar Paper Mill No. 3, Choudwar, for some years.

Shri Senapaty joined the Institution as an Associate Member in 1963.

The Committee of the Orissa Centre of the Institution of Engineers (India) in its meeting held on March 17, 1967 observed one minute's silence as a mark of respect to the departed soul and passed the following resolution: 'Resolved that the Institution of Engineers (India), Orissa Centre expresses its deep sense of sorrow on the sad and sudden demise of Shri G. Senapaty, a Corporate Member and conveys its heartfelt sympathy to the bereaved family.'

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column, a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P.O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

A RETIRED ENGINEER C.E. (Roorkee). A.M.I.E. (India), having over 34 years experience as assistant engineer, divisional engineer, administrative head of an industrial concern and of a technical college, was responsible for design, execution, supervision of construction works of big irrigation reservoirs, tubewells, pumping schemes, flood protection, rver training works, dharamshalas, hostels, workshops including water supply schemes and electrification, etc. Age nearly 58 years but in good health; desires suitable employment as full time engineer. (Office ref. E.S. 285)

SAHU CEMENT SERVICE

Structural Design Competitions

Entries are invited for the following competitions, upto 31st August, 1967.

1. **SENIOR STRUCTURAL DESIGN COMPETITION—1967, as organised annually, without age restrictions.**
2. **JUNIOR STRUCTURAL DESIGN COMPETITION—1967, to be organised annually from current year 1967, with restrictions as to age and experience.**

Both above competitions carry Prizes of Gold and Silver Medals, with substantial cash awards. For Rules and Regulations, also value of the prizes apply with self-addressed stamped envelope 9″ × 4″ to: Chief Engineer, Sahu Cement Service, 5, Parliament Street, New Delhi-1.

HELPFUL BOOKS

New Releases

		Rs.P.
I. I. T. Entrance Guide	V. P. Chachra	5.75
4 Figures Mathematical Tables	N. Choudhury	1.25
Applied Mechanics	R. S. Khrumi	12.50

I Part Examination

Differential Calculus	Shanti Narayan	6.00
Integral Calculus	"	5.00
Analytical Solid Geometry	"	5.50
Vector Calculus	"	7.50
Vector Algebra	"	6.50
Analytical and Applied Mechanics	Clements & Wilson	10.00
Hydrostatics	Ray & Sharma	6.00
Coordinate Geometry of 2 Dimensions	Agashe	2.75
Coordinate Geometry	Subbarao	4.00
Engineering Physics (Heat, Light & Sound—MKS)	B. L. Theraja	17.00
Heat	J. B. Rajan	9.00
Optics	Subrahmanyam & Brijlal	10.00
Sound	Saighal & Sarma	6.50
Basic Calculus and Its Applications	N. Choudhury	2.00
Moment Area Methods	"	3.00
Modern Lettering Styles	"	2.00
Building Materials	"	7.00
Engineering Materials	"	12.00
Railways	"	7.50
Structural Theory & Design (Vol. 1)	"	15.00
Complete Course of Geometrical Drawings	R. C. Singhal	5.00
Principles of Electricity	Page & Adams	10.00
Magnetism and Electricity	D. N. Vasudeva	11.50
Fundamentals of Electrical Engineernig	B. L. Theraja	16.00

II Part Examination

Civil Engineering

Text Book of Building Construction	Sharma & Kaul	12.50
Text Book on Highway Engineering and Airports	Seghal & Bhanot	15.00
Elementary Theory of Structures	R. L. Jindal	12.50
Indeterminate Structures	"	14.00
Elements of Reinforced Cement Concrete	Bhanot & Kapoor	7.50
Steel Tables	"	2.00
Elements of Public Health Engineering	K. N. Duggal	15.00
Design of Modern Steel Structure	Grinter	16.00

Electrical Engineering

Electrical Machine Design	Gray, revised by Lincoln	12.50
Worked Examples in Electro-Technology (M.K.S.A.)	B. L. Theraja	12.50
Text Book of Electrical Technology (M.K.S.A.)	"	25.00
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At the instance of Major General S. P. Vohra, President, this Symposium is being held for the first time concurrently with the Council Meeting. The subject matter has been chosen keeping in view the strategic importance of roads in Jammu and Kashmir and also the fact they form the life line of this border State. Shri K. K. Nambiar (M.), Chairman, Civil Engineering Division, is the Convenor of the Symposium.

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Members of Committee

(*Details not available*)

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Members of Committee

(*Details not available*)

THE ROLE OF COMPUTERS IN ELECTRICAL ENGINEERING *

Introduction

In electrical engineering today, the development process has changed. As a result, increased emphasis is being placed on performance analysis. Engineers are spending more time than ever before on that phase of their work before they begin bread-board development of prototypes. As evolution in design practice continues, speed and accuracy of computation in performance analysis and application modelling become increasingly important. And speed and accuracy are two inherent advantages offered by the computer.

Significance of the computer

When originally used in electrical engineering in the early 1950s, the computer was employed much in the manner of a slide rule. Only large organizations had the combination of computation volume and capital that could justify investment in computer programming and equipment. Since then, these early users have extended their slide rule applications with the aid of new mathematical techniques. In addition, they have expanded their computer applications to analysis, synthesis and optimization studies.

Rapid advances in computer technology have steadily reduced the unit cost of computer use. Systems support, computer programmes, and problem-oriented languages are encouraging new and broader applications. This is why smaller firms now find it feasible to install computers.

Computers and devices have become natural day-to-day design tools of electrical engineers, freeing them from repetitive computations, and enabling them to spend more time in the three creative design areas:

(i) Analysis, or evaluation of alternate designs and selection of new design parameters;

(ii) Synthesis, or development of a satisfactory design from initial performance specifications; and

(iii) Optimization, the development of an optimum design for a specific system or product with respect to performance, cost or other significant factors.

Analysis — a key area for computer use

Working in these three areas with the aid of a computer, the electrical engineer can learn more about proposed designs and their behaviour.

Circuit analysis is a major area of computer application. A circuit is customarily represented by a system of idealized components. This idealized system must not only account for the nominal behaviour of each component, but also for secondary effects.

Various methods of circuit analysis are employed. Numerical techniques using complex arithmetic, matrix methods, and differential equations are widely used in evaluating A.C. and D.C. circuits for steady-state and transient conditions.

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*Contributed by Burson Marsteller Associates, New York.

Engineers can recall a circuit from computer storage and it will be shown on the cathode ray tube of an IBM display terminal

All these methods of circuit analysis, which are relatively slow and cumbersome when executed manually, are ideally suited to solution on computers. Computer programmes are being used for steady-state and transient analysis of circuits with large numbers of nodes and branches of passive and active components. Other programmes generate impedance matrices and accept nonlinear components.

Computer applications

Computers have made it economical to apply synthesis techniques routinely. In filter design, for example, using the method of steepest descent, component values can be selected to minimize the difference between desired and actual response. Filter response characteristics can be computed for various types of inputs. Continuous nonlinear filters, active filters, lossy ladder filters and crystal filters can all be synthesized.

Other computer applications in circuit analysis and design include:

Accurate design of transistor NOR circuits having minimum power dissipation.

Analysis of transistor-resistor logic (TRL) units and compilation of TRL propagation delay tables.

Synthesis of networks with minimum sensitivity to element tolerances.

Analysis and design of power supply circuits for solid-state equipment.

D.C. and transient response of transistor switching circuits of arbitrary configuration.

Sensitivity analysis of networks.

Transient response of distributed parameter networks.

Analysis of time-domain responses for systems described by rational transfer functions.

A circuit analysis programme

An electronic circuit analysis programme has been developed by IBM specifically for electrical engineers. Statements in the ECAP problem-oriented language resemble the engineer's own way of describing a circuit, just as statements in the FORTRAN language are similar to equations commonly used to describe a physical system in algebraic terms.

The ECAP programme can be used for analysis of steady-state D.C. and A.C. circuits and transient behaviour. Based on his ECAP statements to the computer, the engineer receives a report tabulating the voltages at any nodes of the circuit, currents through any branch, and power dissipated by any component.

Control system design

The complexity of many control system models has grown considerably. The need to include the sensing and actuating devices that monitor the process intensifies this complexity.

Computers have been found useful when equations are nonlinear or have coefficients or driving functions not readily represented by basic types of functions. Computers are also vital tools for analyzing control systems having more than one independent variable element that must be described by nonlinear differential equations.

Representative applications of computers in the analysis, synthesis and optimization of control systems include:

- Calculation of the transient error and stability of a process control system.
- Design and evaluation of a control system for a missile weapons system through simulation.
- Synthesis of linear time-varying sampled-data feed-back systems.
- Simulation of a reactor cooling control system to obtain response times for ramp and step inputs.
- Root-locus computations for the analysis of process dynamics and the synthesis of automatic control systems.
- Calculation of impulse responses and the magnitude and phase of frequency-dependent transfer functions; and many more.

Programme for control system design

The Continuous System Modelling Programme (CSMP) is a problem-oriented computer programme designed by IBM specially for analyzing complex control systems. Input to the programme is a description of the control system in block diagram form.

Expressed in the electrical engineer's own language, the arrangement of integrator, function generators, clippers, and delay elements is entered directly into the computer through a keyboard or by means of punched cards, as are initial conditions, parameters, integration times and output intervals. The programme then presents the resulting outputs of elements in the system in either typed or on-line graphical form. This permits the electrical engineer to modify, re-analyze and optimize until he is satisfied with the system design. Days, weeks and months of real-life operations are thus compressed into a few minutes of computer simulation. With CSMP, the engineer is more productive, and his systems design is closer to optimum.

Component design

Motors

Motor design presents special problems to the electrical engineer because of the interaction between the motor's mechanical and electrical systems. A variety of design approaches, wire and core materials, and physical arrangements of components must be considered. The task is further complicated by three marketing factors:

(i) Customized design—the trend to developing special motors for particular applications, rather than adapting off-the-shelf models;

(ii) Shorter delivery times—competitive pressures cut down lead time in both design and production; and

(iii) More sophisticated designs—the demand for more precise, more efficient motor performance.

Manufactures have applied computers to one or more levels of motor design. Many have extended their design programmes to the first stages of manufacturing, particularly in synthesis and optimization. As a result, they have realized three benefits: (i) better designs through more accurate analytical techniques, (ii) faster designs, (iii) lower design costs.

Transformers

Transformer synthesis and optimization are common computer applications today. The accuracy of transformer analysis has been increased with computer programmes that consider the effects of irregularities in the core, windings and insulation. In a number of iterative steps, wire sizes, number of turns and other parameters are varied to achieve an optimum transformer design.

Typical computer applications in transformer design:.

(i) Optimum design of transformer to meet given limitations in weight, physical size or cost.

(ii) Calculation of electromagnetic forces in a transformer.

(iii) Analysis of transformer impulse voltage distributors.

(iv) Study of IF transformers for single sideband operations.

(v) Design of toroidal-core pulse transformers having minimum weight.

(vi) Design of low voltage transformers.

(vii) Design of power transformers having a given range of departure from nominal values.

(viii) Calculation of impulse stress in transformers; and many more.

Subroutines for mathematical analysis

Mathematical computations

There are many computations in electrical design that are relatively straightforward and so present no problem in manual solution except that there are so many computations to be made. Examples of these include simultaneous equations in D.C. circuit and transient analysis, and rational functions in transfer analysis. Such mathematical problems can be effectively solved with the Scientific Subroutine Package (SSP). More than 100 subroutines are available from IBM.

Present computer applications in engineering mathematics also include:

(i) Computation of Fourier transforms to find the power density spectrum of a phase-modulated wave.

(ii) Computation of auto-correlation functions to detect signals masked by Gaussian noise.

(iii) Calculation of gain, and input and output impedances for multistage transistor amplifiers.

(iv) Solution of the nonlinear differential equation giving the frequency, amplitude, distortion and switching times of negative resistance (tunnel) diodes.

(v) Analysis and synthesis of speech directly in the time domain, using auto- and cross-correlation techniques.

Statistical analysis

Prototype characteristics and performance prediction have been handicapped by the extensive computations needed. Now with the availability of SSP, computers can be used routinely for such standard statistical tasks as data reduction and classification, curve fitting and multiple regression, experimental design and analysis of variance, and estimation of statistical parameters.

Systems reliability analysis often cannot use available analytical developments that are designed for studying failure distributions and component designs. Direct statistical evaluation on computers, readily implemented with SSP, can be used to study reliability patterns for various repair policies, component life distributions, and redundancy configurations.

Present computer applications in statistics and reliability analysis also include:

(i) Analysis of circuit reliability, using Monte Carlo methods to generate component values, and analysis of resulting circuits.

(ii) Use of statistical methods in circuit design.

(iii) Maintenance of quality control charts.

(iv) Monte Carlo analysis of base width reproducibility in the construction of double-diffused transistors.

(v) On-line statistical analysis of power supply systems.

Decision tables

The electrical engineering design process often involves many steps that are either non-analytical in nature or are not precisely defined. Data can be selected from tables, or choices made between discrete alternatives. There are significant cost savings possible with standardized selection techniques. However, the informal design procedures acceptable with manual calculations must be precisely defined for the computer.

In the past, it took a long time to write a computer programme. Many hours of joint development by electrical engineers and computer system engineers were required. Each individual application required a special design procedure, as well as a computer programme of its own.

Now all this can be easily accomplished. Decision tables give the engineer with no special knowledge of computer programming but a standard form in which to express the logic and sequence of steps in a particular design process. The computer programme can be developed directly from the decision tables. This technique significantly reduces programming costs, and the programme itself closely approximates the actual design progress. Thus, a design programme can now be developed economically, and if necessary, can be readily modified by another engineer.

Improved man-machine communication

Display units when used with a computer appreciably increase productivity while reducing design cycle time and costs. The electrical engineer is able to observe an image of his design effort. He can, for example, recall a circuit from computer storage, use a light pen to make changes in circuit parameters or connections, and return the revised circuit to storage. He can enter a particular input—random pulses, sine waves, noise output—and observe the resulting output being traced on the screen.

Simple sketches or changes can be made on the cathode ray tube (CRT) by using the light pen in conjunction with the programme function keys which activate computer sub-programmes. Parameter values can be entered by means of an alphameric keyboard. Stored programmes use these parameters to compute design values and to show the results immediately on the display unit.

The electrical engineer can indicate essential specifications or constraints. The design and specifications are then retransmitted automatically to the computer. These new values are displayed with the sketch, and any other desired changes can be made. The process is repeated until the design is optimized.

In applying computer graphics, several iterations in circuit design can be made in a matter of minutes. The engineer checks problem results on the display screen. By selectively altering values, he can seek additional solutions to the problem. With this technique, the time required for a design project may be substantially reduced. A better design is also likely to be produced, since it is now practical to consider many more alternatives in far more detail.

In this article, a variety of ways in which computers may be effectively used by electrical engineers has been shown to help extend their productivity and to permit them to allot more of their time to creative engineering. This survey is not all-inclusive; it covers selected applications from component design, circuit analysis, and control system analysis to illustrate the computer's current role and future potential in electrical engineering.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Bihar Centre

Chairman's address by Shri A. S. Srivastava, B.Sc., M.I.E.E., M.A.I.E.E., M.I.E., at the 20th Annual General Meeting of the Centre on March 11, 1967

After welcoming the Chief Guest, Shri G. Pande, Vice-Chancellor, University of Roorkee, and other invitees, Shri Srivastava thanked the Committee of the Centre for re-electing him Chairman for the ensuing year.

Delivering his Chairman's address, Shri Srivastava said:

'In my last year's speech as Chairman, I tried to highlight, of course, in tune with the current thinking and feeling expressed by such high placed men as Shri C. Subramaniam when he was the Minister for Steel and our late esteemed Prime Minister Shri Nehru, the none-too-happy position in which engineering undertakings are headed by non-professional men and engineers and professional men occupy secondary positions and are not associated in the policy making. I need not repeat the argument why it should be so, nor is it necessary for me to show the effects of the misdirected policy which lacks a technological base and from which all our projects and the economy is suffering. The topic is still a hot one, and the idea still gets ample support in expressions of one form or other. When we, however, scan the horizon of industrial field, we find a state of platitude. Perhaps there is a lack of conviction or confidence to change the outlook and state of existing affairs. To show my point, I quote here the late Shri S. G. Barve, Member, Planning Commission, from a speech delivered on the occasion of 4th National Metallurgist's Day. He said, 'Many of the top policy-makers in western countries are first class minds not drawn merely from the legal profession as in the past but scientists, engineers and economists............There is need, therefore, in our country, not merely to accord to the technician important voice in policy-making progress but indeed to induct suitable professional talents to the highest rungs of the political executives as well' He admitted that there is insufficient realization of the significance of technology and the place of technologists in the march of progress in our present-day scheme of accepted values in India and that giving technological advice the importance that it merits in the decision making process is a most vital and urgently needed orientation for the success of our development plans. This is a matter, indeed, of regret that the blowing winds do not refresh our attitude and outlook, which seems to suffer from inertia of traditions and lack of capacity to reform.

To give a practical shape to the abstract thinking which is epitomized by the quotation from Barve's speech, three steps have been suggested, namely, (i) to constitute the cadre of Indian Service of Engineers; (ii) to make the Chief Engineers as Secretaries of their respective departments; and (iii) to place professional men at the head of all technical organizations.

The first, namely, the constitution of the cadre of the Indian Service of Engineers, though accepted by the Parliament, some three years ago, is still involved in certain controversies over form and procedures. Its coming into being is suffering from indecision and uncertainty. The idea to give the Chief Engineers or Head of the Departments the status of Secretaries has been ventilated in different forums, with a view to eliminate the intervening stage between the Minister and the Head of the Department. It is considered that by this means the proposals of the Head of the Department will not loose its originality and character, decisions will be expedited, responsibility and authority will not be seperated and that the right person will be directly associated with policy-making and decisions.

The three steps mentioned above are actually the base-minimum base for a sound technological structure of the national economic planning execution and operation. It will be absolutely wrong to expect a technical effort to flourish under a general control. It is, therefore, unfortunate that the professional men are still handicapped in their right role and denied the position from which they could make a technological impact on our plans and policies, execution and management. The policy of relegating the technologist to a secondary position is also reflected in status, pay and perquisites. The remedy, of course, lies in the hands of our political leaders who have to break the shackles of tradition for the sake of infusing realism and a dynamic technologically oriented approach to our policies and plans.

Technology, in all directions, is advancing so fast that there exists an acute fear of technical obsolescence in the minds of all professional men who want to keep abreast of the time. Not too far away in the past, 30 years or so, say, in the field of power engineering 650 to 900 lb. per sq. in. pressure, and a temperature of 900° F. for steam generators was usual. The largest size of the electric generator was 50 MW. The usual transmission line pressure was 132 kV, with a few rare instances of 200 kV. Technology has, however, a way not to remain static. Technologists and scientists are a restive lot, keen and burning with fervour to explore new horizons. To secure higher efficiency of generation, reduced capital cost per unit and maximum operational efficiency, steam pressure has reached to the level of 2,300 to 3,000 lb. per sq. in. Turbo alternators are being made in sizes of 500 MW to 800 MW, and exploratory work on larger units is in hand. This has brought down on a pre-devaluation base the capital cost per kW from Rs. 1,000 per kW for a 50 MW set to about Rs 500 per kW for a complete power station using super critical boilers and 500 MW turbo alternators. Power is being transmitted at 700 to 800 kV ; and even in India, which is quite backward, 400 kV lines have been planned during the Fourth Plan. But more spectacular is the advance in the science of control. Power plants are being controlled by computers, closed circuit television is observing from a remote point the operation over the entire plant area, flame conditions are being continually observed by liquid cooled televised lenses and monitored by transistorized devices. Control of atom for generation of power is no longer a dream and commercial plants upto 400 MW in size are in actual operation. Plasma physics has advanced and MHD generators of practical sizes are being experimented upon.

In India, we have to catch up with sufficient leeway. Though in matter of energy growth, our rate has been higher than the normal trend of doubling every tenth year for the world, being 87% for a period 1955-56 to 1960-61 and 124% for period 1960-61 to 1965-66, i.e., over the Second and Third Plans respectively, in absolute terms, we are quite backward. At the end of the Third Plan, national installed capacity was only 11.5 million kW and the per capita consumption 70 units as compared to 7,000-8,000 units for the Scandinavian countries and over 2,000 units in the U.K. In these countries integrated operation of systems has been adopted universally with new concepts of tie-line control, integrated economy of generation and computerized control of loading and central load despatch. This picture of development, dwarfing our own achievements need not unduly depress us, or cause a feeling of inferiority. The upheaval of the Indian economy started only after Independence and only during the First and successive Plans, the role of power as a prime and motive force behind all sectors of development was recognized. We started late, but we are by no means staddlers. Whereas the world is doubling its electrical consumption every tenth year, i.e., at the compound rate of growth of 7½% per year, we have a rate of growth of over 16%. We have further, to deal with a large population multiplying at a fast rate, and a society with a traditionally poor economic base. There is a basic difference in planning from an affluent base and that on a poor base. In the former, the planning is need-based whereas for a poor country it is based on resources. In this context, our target of 22 million kW by the end of Fourth Plan and our need by the year 1980 of 60 million kW according to the estimates of the Energy Survey Committee is not very uncreditable.

The advance in technology and its growing complexity on the one hand, and the expanding demand for amenities and harnessing of the scientific discoveries and new insights into the fundamental laws of nature on the other pose problems for the engineers which are structural in nature. This is a challenge, but also a matter of compromise. The question is how to strike a balance between the efforts of scientists and specialists who are unravelling new technological and scientific horizons and those whose concern is to direct their efforts to practical utilization of the scientific knowledge and to evolve an economic, reliable and aesthetic solution to the needs and convenience of men by controlling and making use of the great resources of nature. I am particularly focussing my thought on this topic because I find that there is no clear demarcation in thinking about the role of a specialist—an engineer scientist, and a practising engineer and to clarify the role that our Institution can play and is playing in synthesizing the knowledge and practice. Our technology is getting more specialized and we know that the price of excellence is specialization, but the knowledge of the specialist lives in a defined compartment, which gets smaller and smaller with more and more specialization. Alone, his skill is uncalled for and his efforts sterile. Therefore, he needs the practising engineer to translate and coordinate and use the specialized knowledge. There is a certain amount of empiricism in engineering profession and certain basic phenomenon and problems whose understanding is imperfect. The specialist attempts to find a more rigorous mathematical solution to the empirical laws, probe more and more into the imperfectly understood phenomenon and solve generic problems and suggest practical use for the scientific theory, whereas the practising engineer evolves practical designs, takes into consideration economic factors, decides between conflicting items and co-ordinates and supervises a number of experts in different fields in finance, personnel and engineering, in order to fulfill a specific engineering task.

It is, therefore, clear that there should be a forum and medium for exchange of ideas and dissemination of knowledge between specialists, and to make the knowledge of the specialist available to the practising engineer. Continuing education and intellectual vigour are the two prime needs of the engineers of the modern age, otherwise he will lapse into technical obsolescence. Further, engineering efforts are integrated. It is hard to conceive of any engineering project which has not an element of civil, electrical and mechanical engineering in it. College education has, therefore, to be broad based so as to induct a student into basic engineering sciences of a fundamental nature. I am frequently asked 'why should one belong to the Institution, and how does one get back his money worth.' I have tried to answer this question in the foregoing para, the epitome of which is that one must belong to a scientific forum 'To avoid technical obsolescence, to learn what others are doing in similar field, and to keep abreast of the scientific and technological advancement.'

Our Institution is unique in the sense that under one forum and one aegis it shelters all the disciplines. It, therefore, gives unique opportunity for cross fertilization of the various engineering disciplines, and side by side lets the particular discipline grow to its full stature under the specialized division.

May I now, with your permission, deal with a topic which has agitated and continues to agitate our minds, namely, the imbalance between the out-turn from the technical colleges and demand for engineering personnel. The imbalance may be regional, with shortage of engineering personnel in one State and excess in other, but in this State, it is presently an excess. The students of the engineering colleges were so perturbed over their fate, that they went on strike. They have been on strike now for well over three months. Strikes are bad because they have a semblance of indiscipline and dislocate the career of the students. I particularly deprecate strikes as it involves loss of valuable time at a formative age of the student, which can by no means be compensated. At the same time their cause has enough ground to agitate their mind and ours. It is reported that over 2,000 graduate engineers are unemployed and the prospect for employment of the next batch coming out of the colleges is also very bleak. A professional education is different from general education inasmuch as a professional man has to seek employment and look for advancement in particular vocation; otherwise national wealth in imparting the education and national talent in acquiring the vocation is utterly lost. There is also quite a good measure of under-employment. Engineering graduates are working as overseers or even in more inferior positions and avenues of futher promotion is almost blocked. This means that national economy has lost upsurgence and is suffering from stagnation.

For obvious reasons, the out-turn from the technical institutions should match the demand, and the avenues of promotion should promise atleast the same prospects as in other Class I services in order to draw men of talents to the profession. There is no doubt that our national planning has attracted considerable thought and contains a profound and incisive approach to our multifarious problems, but it also suffers from lack of realism, uncertainties and over ambitious objectives. The result is that the promise, namely certain level of industrial development on which the planning for personnel was based, has not materialized and we are faced with the problem of unemployment of engineers. We cannot be apathetic to the fate of these budding engineers, who are, and could be, real national assets.

I have no doubt that the production of engineers from our colleges, considering the size of our country, available natural resources in which our country abounds but which are mostly untapped, the development potentials and our pathetic backwardness is not so large as to cause a glut. I understand that the total out-turn from all the engineering colleges in the country is about 24,000 per year. The U.S.S.R., the U.S.A. and smaller countries like the U.K. and France produce a much larger number and employ more engineers than we do in our country. It will be quite impossible for the Government to promise employment within its own departments or projects, or to maintain on doles engineers who will be coming out from the colleges from year to year, nor in a mixed pattern of economy, it is intended that Governmental efforts should contain or confine all sectors of development. The main point is that engineering and technological expansion should have a snow-ball pattern, building round and round a core at a continually growing rate to keep along with it a continuous expansion of economy. If that happens, the problem which faces us now will automatically resolve.

Our engineering efforts call for certain immediate attention. They are :

(i) Building a competent consultancy service and developing the right attitude, so that the industrial undertakings and the consultants work together, complementing the efforts of each other.

(ii) Develop research, with a view to solve the current problems and develop new concepts.

(iii) Develop indigenous designs, so that there is a diminishing dependence and ultimate elimination of foreign collaboration.

(iv) Introduce compulsory technical supervision in all contracts.

(v) Develop indigenous manufacture facilities for maintenance requirements.

We have by now installed such a lot of foreign equipment, that for their efficient maintenance, considerable imports of maintenance materials and spares, involving a considerable amount of foreign exchange, estimated to be approximately of the order of Rs. 400 crores per year will be needed. This is a perpetual drain of our meagre resources and calls for concerted engineering effort.

These are channels of considerable dimensions. Proper exploitation and development of these channels will, in addition to optimising our engineering efforts, open the floodgate for demand for engineers and technologists The solution, therefore, to the present depressing outlook for the engineering personnel, is : (i) Establishment of design organization in the various engineering fields; (ii) Foster basic and operational engineering research; (iii) Develop consultancy services, and engineering of jobs in replacement of foreign collaboration; (iv) Give suitable training in small industries with engineering base to fresh graduates, followed by necessary financial and technical aid to establish them as entrepreneurs; and (v) Make a condition in every contract for employment of adequate number of supervising engineers.

I have taken considerable time of you all and I thank for a patient hearing but I could not get a better oportunity to open my mind before such distinguished gathering and to enliven an interest on the some of the problems facing the profession. I am glad to inform you that the main Institution building is almost complete but we need an auditorium very badly. We also need cooperation and more active participation in the activities of the Institution from our brother engineers, and from the engineering students to make our student chapter a more helpful and dynamic institution. With these words, I request Shri Pande to inaugurate this session'.

Madras Centre

Chairman's address by Brig. M. A. Nayudu, B.E., M.I.E., at the 44th Annual General Meeting of the Centre on December 23, 1966

After welcoming the Chief Guest, Shri D. Sanjivayya, Union Minister for Industries, and other invitees, Brig. Nayudu thanked the Committee of the Centre for electing him Chairman for the ensuing year.

Delivering his Chairman's address, Brig. Nayudu said:

'I also consider this an honour to the Corps of Engineers of the Army, for it is exactly after 40 years that a soldier-engineer has been once again elected as the Chairman of the Madras Centre. I am conscious of the responsibility that goes with this honour and I pray that I may have the strength to justify the confidence that has been reposed in me. In this responsibility, I feel a little overwhelmed and diffident. It is because in this Chair, I am succeeding so eminent a person as Shri Mahalingam, who is an engineer, an industrilist and also a politician. I may not hope to match his talents, but I can perhaps take solace in the thought that after all men like Shri Mahalingam are rare and few.

Sir, you have all the information about our Madras Centre in the annual report given to you. I wish to briefly refer to a few outstanding features regarding the Institution.

The Institution of Engineers (India) was first inaugurated in Calcutta in 1921 and has now an All-India membership of over 56,000 The Madras

Centre has shown a steady increase in its membership during the last year, the present strength being over 950 Corporate Members and over 4,600 Students and Graduates. The Institution of Engineers (India) has been constantly pursuing one of its primary functions, namely, to train engineers. Whenever special studies of particular problems were required, the Institution has been making its contribution. For example, during this Annual General Meeting, we are having a seminar on 'Engineering Industries and Their Development'.

The Institution of Engineers (India) is perhaps the only one of its size in the world and has members of all engineering faculties, *e.g.*, Civil, Mechanical, Electrical, Mining, Metallurgy, Chemical, Telecommunication, Railways and others under one roof. In short, it has become a temple of engineering emanating knowledge on all engineering subjects. It is gratifying to note that our Government has not been slow in recognising the importance and usefulness of this Institution. Your very presence here this afternoon substantiates my statement.

As a soldier-engineer, I might be expected to talk something about military engineer affairs. As a member of the Corps of Engineers of the Army, I can probably say that we are perhaps the single largest engineer organization in the country, and that we have been keeping up to the motto of the Corps, which is *Sarvatra*, *i.e.*, 'To be everywhere'.

The Army Engineer is required to be either right up in the front line of the battle, clearing enemy mines, building bridges or he may be required to be the last man to withdraw after blowing a bridge. The engineer functions are very varied and diversified, be it building roads or ropeways at very high altitudes and in undeveloped terrain, be it building harbours and airfields with the latest techniques, be it building factories and laboratories with their present day sophisticated requirements The work envelopes civil, electrical and mechanical engineering activities extensively and also necessitates meeting the engineer requirements of the Army, Navy, Air Force and the defence factories.

In order to ensure that the Corps of Engineers officers are able to discharge their technical functions efficiently in war, it is essential to restore the old practice of sending these officers during peace-time on deputation to various departments like P.W D., Railways, Ports and public and private industries. Such a practice exists widely in the United States, and it is hoped that our Government would also agree to similar measures. Let it be clearly understood that such a measure alone will ensure an efficient technical arm of the Army in times of war and also let not such a step be misconstrued as a measure for any additional employment.

It is being increasingly realized that the military strength of a nation is primarily dependent on its technical strength. A Russian General had stated that 'Military Technology is connected with the entire industry and economy of the country in a multitude of ways. The level of development of Military Technology depends directly on the level of economic and technological development. Therefore, to the military engineer who has to apply engineering knowledge to the furtherance of the military plans, a study of the economic and technological development is of paramount importance.

Technical and production forces of a nation exert an enormous influence on military affairs. It can be easily stated that every engineer, who in some form or other, contributes to the development of the nation's engineering potential is contributing directly to her defence.

The conflict which we have had with Pakistan last year had no doubt made the country more defence conscious and had also instilled the necessity for self-sufficiency in the sphere of defence equipment and defence production.

These hostilities had brought out certain specific lessons of engineer's concern. Some of them are:

(i) We should manufacture weapons and equipment to give useful service for as long a period as possible, which also calls for better care in handling and operation and higher standards of maintenance. This also necessitates re-orientation of ideas on repair of equipment and to bend our energies towards greater improvization and maximum reclamation of spares and parts.

(ii) The construction of strategic and tactical roads on border areas must be carried out speedily without lowering the heavy specifications that would be required, including elimination of the biggest item like dust nuisance.

(iii) The Indian Railways had done a very remarkable work in the movement of military formations and troops but they have to device ways and means of loading and unloading goods and equipment quickly at any way-side station and also for carrying out repairs of damaged bridges with maximum speed.

(iv) The Indian Air Force has made valuable contribution to the land battle. But there is the necessity to achieve a very high standard of maintenance of aircraft and also the necessity for ways and means of quick repair of runways so as to reduce enemy interruptions to the absolute minimum.

(v) There is need to concentrate on the development and production of telecommunication equipment with greater determination and vigour, because in the fog of war unless the Commanders have efficient system of inter-communication they would not be able to control and direct the military operations.

Various measures have already been taken in hand to achieve the above mentioned requirements. There has been considerable enlarging of the ordnance factories and other defence production units. A new department of defence supplies for the purpose of coordination has been created. But the working of the newly created department along with the Ministry of Industries, Ministry of Supplies including the Technical Development Directorate, is yet to be seen and it is the hope that the joint work would prove successful in mobilising the industrial potential of the country and in accelerating the pace of defence preparedness. There is a need for bringing the private sector into the field of defence production, not only from the point of view of competition but also for making maximum utilization of existing resources. The country's industry must be defence oriented to enable a quick switchover when required in war.

A rapid advancement of technological development and full utilization of new techniques cannot be achieved unless and until due attention is given in the country for research and development. It is also necessary for establishing closer liaison between the allied departments under the Ministry of Defence, Ministry of Industries, universities, and also the Council of Scientific and Industrial Research (C.S.I.R.). Although a lot has been achieved already by the C.S.I.R. and allied departments under the Ministry of Defence, I feel that industrial research falling in the purview of industry is being neglected. Universities also have not played their full part in the promotion of research studies. The Government should encourage the expansion of laboratories in the private sector and in deserving cases subsidise them to the extent required, because industrial progress is in many ways directly related to the interest displayed and the effort deployed on research and development by a nation.

In the field of industrial management we have not been giving enough consideration and thought to the subject of operational research. Operational research is the application of scientific methods and techniques to problems involving the operation of a system with optimum solutions to the problems and must not be confused with familiar items like work-study, etc.

It is generally acknowledged that advanced techniques with modern outlook have been adopted in industries which is a healthy sign. But in the field of administration we are behind time perhaps by about half a century and are still depending on outmoded rules and proceduress. The mechanics of arriving at a technical decision is generally by quoting past precedents and relying on 'instincts' and 'compromises'. With bureaucrats at the helm of administration, actions of technical men perhaps remain rigid and far removed from the changing and growing needs and aspirations of the people.

The theory that is normally advanced by the bureaucrats in that there is a shortage of engineers in the country and therefore the latter must not be burdened with administration. They also argue that being technical men, the engineers can see only their point of view and do not appreciate the inter-relationship with the social and human problems. Thus they justify the need for a civil servant to interpret the technical views 'impartially' to the Minister and the decision making body.

We can no longer accept the theory that a generalist administrator brought up to collect revenue and enforce criminal law in the district is better qualified to run a technical department because of his emotional detachment; nor can we accept a system of administration in which the country's highest civil and militry professionals have to subject themselves to the infructuous and unnecessary task of educating a secretariat. The country cannot progress unless the professionals are given their due place, and it can ill-afford the luxury of a tier of ignorance between policy making authorities and the executive.

It is disheartening to see that the out-dated rules and procedures applicable to Government departments have also been extended to the public sector undertakings, where the systems should be progressive business-like and modern in their outlook and functioning. The result is red-tapism, fat files, delay, low return for capital invested and shortfall in production.

The Government have appointed the Administrative Reforms Commission. It is hoped that the Commission would not ignore the vital technical links of our society and that it would look 'forward' to the requirements of a modern technological society.

The President of India, Dr. Radhakrishnan, in his report to the University Education Commission as early as 1949 had stated that the ideal head of an organization like a large factory, *e.g.*, Tata Iron and Steel Co. Ltd., should be an executive who is also an engineer. 'Although some of such organizations were headed by administrators who have done their job well, there have been many failures or cases of gross mis-management. It is preferable that engineers and scientists are heads of departments in such business'.

Honourable Shri C. Subramaniam, Union Minister for Food and Agriculture, had stressed the necessity of giving more powers to the technical heads while he was in the Steel Ministry and he has also reiterated this opinion even with regard to the problems of Food Ministry at an earlier date and also a few days ago. We do hope, Sir, that you will consider favourably the chances of associating the technical personnel for top management in your Ministry.

There is no doubt that it is also the duty of the professional engineers to prove their worth by their talent and knowledge and the performance of duties. The engineers of the country do have a great responsibility when as much as 70% or over of the total proposed investment in the Fourth Five-Year Plan is to be utilized through the engineers of the country. Only when the engineering profession puts in hard work, can it hope to achieve the respect and responsibility that we all aspire for. For this purpose it would be appropriate for me to conclude my address by recalling the wise words of our beloved Pandit Nehru. He said, 'Fortune is a hostage which has to be zealously guarded by our own good work and which has a tendency to slip away if we slacken in our efforts or we look in a wrong direction. There can be no good work for the nation without hard work. Let us, therefore, dedicate ourselves on this occasion to another year's hard and sincere work'.

Now, I have great pleasure in requesting Honourable Shri Sanjivayya, Union Minister for Industries, to inaugurate our Annual Session.'

Gujarat Centre

Shri Nandubhai K. Patel has been elected as the Chairman of the Gujarat Centre for the year 1967-68. The Chairman's Address delivered by Shri Patel at the Seventh Annual General Meeting of the Centre has been printed in the *Bulletin*, vol. 16, no. 8, April 1967, p. 13, without his photograph.

Summaries of Papers Published in the Journal, vol. 47, no. 8, pt. HI 2, April 1967

HINDI SECTION

1. **Removal of Stains from Concrete Floors. S. C. Jain,** *Non-member.*

Practically all types of stains can be removed from Portland cement concrete floors without appreciable injury to either texture or colour of the concrete. A stain may be eradicated by dissolving the staining matter and drawing it out by capillary suction; by driving it back from the surface or by converting the colouring matter into a form which does not show as a stain. It is not always possible to determine what the staining matter is and hence the treatment sometimes has to be a matter of experimentation. Often the staining matter will be found to exist in a stable form and its removal may require several applications of the treatment. This is particularly true in the case of stains which have been long neglected. Considerable patience is, therefore, required to eradicate such stains. It is often a matter of repeating the treatment day after day until the desired results are obtained. A wide range of stains are encountered on concrete floors but the more common ones are ink, iron and rust, oil, paint and varnish, bitumen and asphalt, coffee and tea, tobacco and some other less common stains are described in the paper.

2. **Masonry Mortars. Inamul Haq,** *Non-member.*

Mortars are of several types having some difference in the properties. Therefore the selection of mortar should be done to suit a particular type of work. Selected mortar should impart to masonry adequate strength and resistance to rain penetration. The strength of masonry increases upto a certain limit with the increase in the strength of mortar, beyond which there is practically no gain in the strength. The strength of masonry is not proportional to the strength of the mortar and a rich mix does not necessarily increase the strength of the masonry. The bricks in India have generally a high suction capacity and tend to draw water from the mortar before it hardens. So, mortars having high water retention capacity are preferable. Also the strong mortar should not be used in the masonry as it will crack away from the unit due to initial drying shrinkage

3. Bridge Engineering in India. S. B. Joshi, *Member.*

A Hindi translation of the Tenth Sir Mokhsagundam Visvesvaraya Lecture delivered by Shri S. B. Joshi during the 47th Annual Convention of the Institution of Engineers (India) held in Bombay on February 26, 1967, has been given. The Lecture traces the growth of bridge engineering from ancient times in India from the ropeway hanging bridges to modern prestressed concrete bridges. It describes briefly the theory of designing of foundations and masonry, steel and concrete, super-structures, and launching of steel girder bridges

4. A Permanent Exhibition—N.B.O. Display Centre. G. C. Mathur, *Non-member.*

The housing situation in India and particularly in big cities is far from satisfactory. Besides the paucity of financial resources, the common-man lacks the technical know-how as regards house building matters. Right selection and proper use of materials can result in considerable savings. Realizing this, the National Buildings Organization (NBO) which is also a Regional Housing Centre of ECAFE, has established a Permanent Building Exhibition Centre in Nirman Bhavan at New Delhi. The Centre is non-profit making but self-supporting and is intended to promote healthy competition with a view to improving the quality of products and to establish a constant link between the users and the manufacturers for promoting the development of building industry.

Besides, the Permanent Exhibition, the N.B.O. provides a library documentation service and undertakes to disseminate technical as well as trade information. The Centre entertains enquiries on phone and through correspondence. Temporary exhibitions lectures, seminars, film-shows, demonstrations, etc., are organized by the Centre from time to time to inform architects, engineers and house-builders about the latest developments in the field of building and housing. In this article, some activities of the Centre and those of leading Building Centres in Europe like the one at Bouwcentrum at Rotterdam, the Building Centre in London, Byggcentrum, Copenhagen, Svensk Byggtjanst, Stockholm, and CIDB in Paris have been briefly mentioned.

5. Machine Foundations. Shamsher Prakash, *Associate Member,* **and Gopal Ranjan,** *Non-member.*

Special problems in connection with the proportioning of machine foundations have been discussed in this paper. A brief review of different approaches for analysis of a block machine foundation along with the details of a vibrator test have also been included.

6. **Problem in Road Construction in Desert. B. L. Prashar,** *Non-member*

The construction of roads in deserts presents a serious problem. The most important construction materials such as stone and water are scarcely available in arid zones. The only material available is sand. Big sand dunes are formed during windy season. Transportation of materials is also not feasible in the present economic conditions. In some areas, a soft type of aggregate either in a boulder form or in a nodular form containing a high percentage of silica and calcium oxide is available. In view of all these factors, cost of road construction in desert areas with conventional methods is very high. Utilizing the sand-bitumen stabilization, a cheaper and easier method, the problem has been solved. The use of bitumen for stabilizing sand has been widespread in foreign countries. Use of certain chemicals has also shown encouraging results. A cheaper material for road building in desert area could be local sand properly stabilized providing cohesion between the sand particles by suitable bituminous binder.

7. **Elementary Principles of Prestressed Concrete. Vishwambhar Prasad,** *Associate Member.*

To withstand compression, concrete is the cheapest material at many places. But its strength in tension is far less—about 10 to 15% as compared to its strength in compression, and that too reduces to zero on account of cracks due to shrinkage in course of curing. About the year 1900, the principle of reinforced concrete attained maturity, and steel reinforcement was used in the tension zone which could take up the entire tension. Thus, a very simple construction process gives a material which is equally strong in tension as well as compression. But the defect of the R.C.C. is that the concrete in the tension zone simply adds to the dead load, it is of no use except as a connecting link between the steel and the concrete in the compression zone. This defect of the R.C.C. is removed by introducing beforehand a stress of the opposite nature. This is called prestressed concrete, which goes two steps ahead of the R.C.C. : (i) the concrete in the tension zone is kept already so much compressed that on applying the loads for which it is designed, the compression gets reduced, yet no tension is caused; and (ii) the compression introduced beforehand, i.e., the prestressing is so applied that the bending moment due to this is opposite in nature to the bending moment caused by the entire live and dead load. For instance, in a simple beam the superimposed loads generally cause position moment, therefore, negative bending moment is produced in it by prestressing. This paper deals with simple principles of prestressed concrete which may be helpful to the students of engineering in understanding its design. For the sake of brevity other details of designing and specifications of material are not given.

8. **The Problem of Radio Interference from High Voltage Power Transmission Lines. V. N. Rikh,** *Associate Member*

Today with the introduction of higher and higher voltages, the problem of radio interference generated by power transmission lines has assumed important proportions. The inherent electric discharges from the surface of conductors and other accessories of the transmission line, when energized at a high voltage, emit radio-noise waves of various wave-lengths which, if not properly controlled and kept within specified limits, may cause serious disturbance in radio-reception in the vicinity of transmission lines. Proper care has, therefore, to be taken in design, construction and maintenance of high voltage transmission lines so that the interference is kept to a minimum and within tolerable limits. In this paper the factors which effect the radio interference, methods of assessing the interference level in individual cases as well as various means of reducing the same to a minimum, are presented.

Summaries of Papers Published in the Journal, vol. 47, no. 9, pts. CI 5, ME 5 and ET 3, May 1967

CIVIL ENGINEERING DIVISION

624.04:624.075.2

1. The Design of a Column. F. Basu,

The current codes of practice are not very satisfactory so far as the design of a column is concerned. I.S.:800 is guided by the American practice and is based on the 'secant formula'. The British practice is based on the Perry-Robertson formula. Most of the other codes are minor variations of the accidental eccentricity and initial curvature formulae.

The basic approach in the codes is to find the permissible axial load for a given ratio of length to radius of gyration; when a lateral load is present, the effect of this is compounded by a semi-empirical equation in a second step. Such an approach is open to several criticisms of which two are important. These are: (i) Why should two different equations be necessary to design the column? Since most real columns carry some lateral force, why not devise a suitable equation? In fact, it is never possible to apply an exactly vertical force. Apart from wind, surge and similar separable forces, a vertical force is always accompanied by a lateral force, the magnitude of which depends on the type of connection and temperature. (ii) Following the codes, how does the designer calculate the actual deflection under the combined vertical and lateral forces? The 'limiting deflection under lateral forces' of the codes is not and can not be the actual deflection. The codes are silent about the actual deflection. The method of design suggested in this paper answers the above questions.

627.8.001

2. A Rational Approach to the Problem of Fixing Optimum Heights of Multipurpose Reservoirs with Special Reference to the Proposed Tikarpara Dam. Prof. B. Behera, *Member* and P. K. Mohapatra, *Associate Member*.

In this paper, the authors present a new method of determining the relationship between water demand and live storage in multipurpose reservoirs with or without carry over storage. The superiority of this rational method over the known methods of storage calculation from dependability curves, mass curves and working tables has been indicated. The use of the method has been illustrated in determination of the optimum height for the proposed Tikarpara dam on the river Mahanadi in Orissa.

624.072.3.001

3. Analysis of Rigid Frames by Kani's Method. Dr. S. K. Mallick, *Non-member* **and Dr. K. S. Rangasmi,** *Associate Member.*

Kani's method 1 for the analysis of statically indeterminate frames is an outstanding contribution to structural analysis. The aim of this paper is to illustrate this elegant approach; the derivations have been explained from fundamental concepts and several examples have been worked out to demonstrate the ease and speed with which the final results are obtained to any desired degree of accuracy. The scope has been limited to frames with vertical and horizontal members of uniform section.

627.2

4. Sea Defence Works—Groins and Revetments. Dr. M. Manohar, *Member.*

This article deals with the latest designs and installations of groins, and revetments in sea defence works. The author believes that such defence works can remedy a large number of similar situations found in India for which large expenditures are incurred by improper coastal protection works and in which many millions of c.m. of shoreline are being lost into the sea.

626.861

5. Flow Around Bends. Dr. H. S. Nagabhushaniah, *Non-member.*

The paper deals with the flow around the bends in open channels. It discusses the super-elevation, spiral flow in the channel, free vortex motion, flow around a single 180° bend and flow around a series of bends. It also outlines the scope for further study on flow around bends in open channel.

627.8

6. Flow Through Homogeneous Earth Dams. S. Panchanathan, *Member,* **J. Devarajan,** *Associate Member,* **and S. B. P. John,** *Non-member.*

A study of flow through homogeneous earth dams is necessary for a dependable design. This study involves the determination of the line of seepage. The Casagrande solution for location of the line of seepage does not take into account the position of the filter point relative to the entrance point. In this paper the results of a study of the lines of seepage as obtained by electrical analogy method as well as by Casagrande's formulae 2 and Polubarinova-Kochina formulae are discussed and compared. The lines of seepage are obtained for five different positions of the filter, for upstream slopes varying from 0° to 90° at 15 interval. A plot relating $\frac{h}{L_{dr}}$ to $\frac{h}{L_{s}}$ is obtained for each of these slopes. To obtain the curves for the practical slopes of 1:½, 1:2, 1:2½ and 1:3, a double interpolation method using Lagrange's interpolation concept is devised. The coefficients in the interpolation polynomials are obtained using the IBM 1620, digital computer. The results obtained are verified by experiments and found to be within limits of allowable error.

627.8 : 624.16

7. **Anchorage of Piers in Masonry Spillways. G. N. Pande,** *Non-member,* **and R. V. Ranthidevan,** *Associate Member.*

An approximate method to determine the minimum anchorage depth for reinforced concrete piers in masonry spillway dams is discussed. The principle of a beam on an elastic foundation is used in this method and graphs have been developed to provide a ready solution without the necessity of solving a series of equations involving iterative calculations.

624.04 : 624.075.2

8. **Design of R.C.C. Columns Subject to Biaxial Moments. C. V. Rama Rao,** *Associate Member.*

The R.C.C. columns, subjected to bending about one or both the axes, are designed by 'trial and error method'. If the number of columns to be designed are large, the method will be quite laborious and highly time consuming. This paper gives relationships which help in evaluating the bearing capacity of columns with eccentricity about one or both the axes.

624.075.2

9. **Design of Steel Columns Block in Bharat Heavy Electricals Limited, Hardwar. Ramesh Chandra,** *Associate Member,* **and U. S. Tewari,** *Non-member.*

Block No. II had four bays, out of which two bays had steel columns. These bays had spans of 24 m. and 36 m. Roofs were at different heights. Crane capacity was upto 75 tonnes. One end of the roof was fixed with the column and the other end hinged. The analysis had been done by exact method without any assumption with respect to the points of contraflexure.

624/628.002.2 : 681.3

10. **Computer Applications in Construction. M. Varma,** *Associate Member.*

The paper presents some of the computer applications used by the construction industry in the U.S.A. at the present time. The actual programmes intended for use of IBM 1620 FORTRAN with FORMAT algebraic compiler are presented, together with data input and results. The examples selected pertain to planning and scheduling, cost estimating and cost accounting which are commonly encountered in all construction works.

684.6 : 624.074.2 : 624.97 (548.2)

11. **Some Aspects of Granite Stone Veneering to R.C.C. Dome and Tower in Vidhan Soudha, Bangalore. M. B. Krishna Iyengar,** *Member,* **and D. S. R. Gupta,** *Non-member.*

The paper gives the construcion details of the Vidhan Soudha Building, Bangalore. It discusses some aspects of granite stone veneering over such members of the building which had to carry heavy loads and were designed as R.C.C. structures. The details of the design of the main dome, tower, Ashoka Emblem, main dome columns, and the foundation of the main dome have also been included.

SHELL STRUCTURES GROUP

624.072.4

12. Doubly Curved Shells in Oblique Co-Ordinate System. S. P. Banerjee, *Member.*

This paper deals with doubly curved shells, the principal axes of which are not at right angles. The analysis of such shells have mathematical limitations, and a numerical approach thereto has, therefore, been evolved. The results of Candela's solution of a problem have been found to be radically different from those given by the present method in the paper.

RAILWAY ENGINEERING GROUP

625.22 : 625.27

13. Safe Speed of Trains on Railway Curves. R. K. Jain, *Associate Member. Member.*

The schedule of dimensions for various gauges gives recommended safe speed on fully transitioned curves in Indian Railways practice. The formula for broad-gauge (B.G.) and metre-gauge (M.G.) is V' (in km. per hr.) $= 4.4. \sqrt{R' (m) - 70}$ and for narrow gauge (N.G.) V' (in km. per hr.) $= 3.65 \sqrt{R' (m) - 6}$. The recommended adhoc formula for B.G. and N.G. appears to have been included in the 'schedule of dimensions' on the recommendations of the Indian Railways Conference Association. A critical analysis of the formulae for B.G. and M.G. was done by Proctor in his paper 'Determination of Permissible Speed on Curves', who recommended certain alternative formulae. The adhoc formulae have, however, continued to be accepted in practice on Indian Railways. The author has attempted to discuss these formulae and to arrive at a different expression for various gauges based on a more rational approach with the available knowledge on the subject and suggests revision of the existing formulae.

ROADS AND ROAD TRANSPORTATION GROUP

625.75 : 624.131.001

14. Experimental Study of Different Types of Sand Bitumen Mixes. K. N. Sharma, *Associate Member,* **R. C. Joshi,** *Non-member* **and P. S. Kandhal,** *Associate Member,*

The paper describes the behaviour of various sand-bitumen mixes (dry sand mixes and wet sand mixes with varying percentages of binder) based on data of many laboratory and field tests such as, cone-penetrometer test, modified Hubbard field test, cohesivity test, North Dakota Cone test, california bearing ratio C.B.R. test, etc., so as to ascertain effect of mixing time, age curing, aeration, compaction, binder content, temperature, chemical additives on the strength and stability of these mixes. The test results have been interpreted and discussed. A brief account of initial work done, materials, tools and plant used and comparative cost data has also been incorporated. Various conclusions have been arrived at which shall be helpful in selection of suitable mixes after finding optimum binder content, density, void ratio, mixing time, etc., as suited for the type of sand (particle size distribution) available and climatic conditions in the arid zones and which shall form a basis for any large scale venture of adopting these mixes in sandy areas.

MECHANICAL ENGINEERING DIVISION

681.121.8.001

1. Characteristics of Dall Flow Tube. S. K. Acharya, *Non-member.*

Dall flow tube is one of the differential pressure flow meters whose length is nearly twice its diameter. Due to its constructional features, the differential pressure head measured is very high. An attempt is made in this paper to calibrate this tube and find out the shape of the calibration curve. The head loss characteristic is also studied. The low head loss reduces the pumping power requirement and hence saves power consumption for pumping fluid.

621.9 : 621.3.035

2. Mechanism of Electro-Erosion Machining. J. Banerjee, *Associate Member.*

Electro-erosion machining has brought great changes in the metal cutting field. In this process, no conventional cutting tool is employed and electrical energy is directly utilised for machining operations. The technique includes the electrolytic process, electro sparking process and electro-arcing process, and their various combinations. This paper presents the different mechanisms required for the process and its applications in industries.

539.38

3. Stress Relieving Effect of Neighbouring Notches. J. Bhattacharya, *Non-member.* **and B. N. Das,** *Non-member.*

Stress concentration factors for a central notch as influenced by two adjacent notches in a beam under pure bending have been measured using two sets of values for beam width and depth of the central notch, keeping the same notch radius for all the notches. In each series, the stress concentration factors of the central notch were determined with varying notch separation and depth of the adjacent notches. From the experimental graphs, empirical relationships were obtained giving percentage stress relief at the root of the central notch in terms of the above two variables.

625.282 : 629.1.073

4. Locomotive Stability at Speeds. K. Bhattacharya, *Non-member.*

With the increase in speed of locomotion due to Dieselization and electrification, the study of wheel-rail reaction has assumed great importance. Various methods of evaluating locomotive stability at speeds by electrical measuring devices like weighbars, measured rail, strain-gauged wheel and lastly by ride index have been described and the limitations offered by each method mentioned in the paper. The Indian Railways started using weighbars since 1937 for evaluating the stability of steam locomotives. The duration of action of lateral force and the instantaneous loading and unloading of the wheel imparting the maximum pressure are two other factors which have bearing on locomotive derailment. Measured values of lateral forces have been tabulated for steam, Diesel and electric locomotives under service conditions on the Indian Railways and are compared with Blondel's empirical limit.

621.313 : 538.43

5. **Mechanical Causes of Noise in Electrical Machines. A. K. Dhol,** *Associate Member*, **S. K. Goyal,** *Non-member*, **and K. Kant,** *Non-member*.

Noise in electrical machines is mainly due to the mechanical and electrical reasons. This paper discusses the mechanical causes of noise in electrical machines.

662.997 (540)

6. **Designing of Flat Plate Solar Collectors for India. H. P. Garg,** *Non-member*, **and C. L. Gupta,** *Non-member*.

In this paper a rational design procedure has been outlined by which a flat plate collector configuration is chosen and its required area determined in terms of the climatic and operating conditions for any desired output. The required functional specifications are different for different applications like water heating, space heating, air conditioning, etc. Design curves based on the meteorological records of monthly average daily solar radiation and ambient temperatures have been presented for four widely separated locations in India, namely, Poona, Delhi, Calcutta and Madras for summer and winter seasons. An illustration is given to show how the design curves can be used for designing solar collector for water heating.

532.5 : 530.17

7. **Similarity Solutions of the Power Law Fluid Flow for the Natural Free Convection. K. Lal,** *Non-member*.

Possible similarity solutions of the equations which describe the steady free convection flow past a vertical flat plate have been obtained by the method of two group transformations. Three possible cases are discussed and it has been shown that the work of Na and Hasen becomes a particular case of this paper.

621.9.02.001

8. **On the Variation of Coefficient of Friction at the Chip-Tool Interface. P. Mitra,** *Non-member*, **and Dr. A. Bhattacharyya,** *Associate Member*.

The coefficient of friction which is calculated from the ratio of friction and normal force determined from Merchant's circle diagram is an approximately average one. In this paper, the method of determining the coefficient of friction at chip-tool interface of the tool from a few physical and experimental quantities is shown.

621.971 : 621.85

9. Some Fundamental Concepts on the Design of Pneumatic Hammers, R. K. Mukherjee, *Non-member.*

A pneumatic hammer is a short-stroke falling-weight hammer assisted and controlled by pneumatic power developed in a compressor located within the body of the hammer. Compressed air serves to (i) increase the blow energy of the tup, and (ii) raise the tup at the end of the stroke. In this paper, the salient features of a pneumatic hammer developed at the Central Mechanical Engineering Research Institute, Durgapur are given

621.882.6.001

10. Design Considerations in Prestressed Bolts. G. V. Ramanaiah, *Non-member,* **and C. Mohan,** *Non-member.*

It is normally assumed that the effect of external load on preloaded bolts is negligible. The analysis in the paper shows that the effect is of considerable magnitude.

532.5

11. Some Fluid Dynamic Aspects of Film Cooling Employing Angular Injection. G. Rama Subha Reddy, *Non-member.*

For film cooling employing angular injection, an analysis for the length of the zone of influence of the coolant fluid, in terms of the angle of injection, slot passage width, and the ratio of mass velocities of free stream to injection is presented and compared with the experimental results.

621.941.001

12. Static Rigidity of Lathe Beds by Model Analysis. V. Sundararajan, *Non-member,* **and Dr. A. K. De,** *Associate Member.*

Model analysis for complicated structures in machine tools is an accepted practice now-a-days in many advanced countries. The paper discusses the methods adopted to determine the bending and torsional rigidity of Warren type lathe beds, first on perspex reduced scale models and then on fabricated mild steel prototype bed. The model law is found to give results having an accuracy of 15%. Optimum value of the staggering angle for the ribs lies in the range 50° to 55° for bending and 60° to 65° for torsion

621.7.001

13. Experimental Investigations on Explosive forming of Metals. N. K. Tewari, *Non-member,* **and T. R. Mohan,** *Non-member.*

This investigation was conducted to study the effect of various parameters on the maximum deformation of the sheet metal blanks subjected to an underwater explosive charge. It was found that the hydrostatic head has no appreciable effect on the maximum deformation if the head was more than a limiting one. Further, by increasing stand-off distances, the deformation was found to decrease. On the basis of the results obtained, the effects of explosive parameters on the deformation of metal blanks are formulated which can be used in the design for production of components by this process. The plastic work done on the deformed specimen has been determined which has been found to correlate favourably with the energy received by the blank from the explosive charge. An appreciable increase in hardness and reduction in thickness were observed after the deformation process.

ELECTRONICS AND TELECOMMUNICATION ENGINEERING DIVISION

621.39.001

1. Networks Realizing Bisextic Minimum Positive Real Functions. J. G. Advani, *Non-member*, and P. K. Baokar, *Non-member*.

Network structures containing seven, ten and twelve elements and capable of realizing bisextic minimum positive real functions having $\text{Re.}\,Z(j\omega)=0$ at three real and distinct frequencies and also having $Z(0)=Z(\infty)$ are presented. Conditions on the coefficients of given $Z(s)$ so that it is realizable by any of these networks are found out. The values of the elements in the various networks are also found. The conditions on the coefficients of a bisextic positive real function so that it has $\text{Re.}\,Z(j\omega)=0$ at three real and distinct frequencies are also presented.

621.317.772

2. A Direct-Coupled Low-Frequency Phase Meter. A. K. Mohanty, *Non-member*, and T. Natarajan, *Non-member*.

This paper describes a meter to read difference in phase between two electrical quantities which vary over wide range of frequencies, particularly low frequencies as encountered in servomechanisms. The meter is quite accurate, can pick up signals of strength as low as 0.1 volt and its working is independent of the input waveforms.

621.397.001

3. Limitations on the Performance of a Television System due to Phosphor Decay. P. S. Moharir, *Non-member*. and K. V. Saprykin, *Non-member*.

The choice of phosphor for a picture tube screen is dictated by several considerations. But even if the decay characteristic were the only consideration, it can be shown that the full visual capacites of the eye cannot be satisfied. These limitations arise because of the contrast range allowed by the phosphor and the differential flicker due to its decay. The optimization conditions have been derived and it is shown that silicates and tungstates would be better for television use compared to sulphides.

621.372.54

4. On Nonequi-Ripple Approximation. S. N. Rao, *Non-member*.

Equal-ripple or Chebyshev approximation for the ideal low-pass filter characteristic is well known. This paper suggests a magnitude function which gives a nonequi-ripple approximation and considerably reduces the ripple in the passband with only a slight increase in the 3-dB bandwidth. The proposed magnitude responses are drawn for the third, fourth and fifth order approximations and compared with the respective Chebyshev approximations.

AUTOMATIC CONTROL GROUP

621.39.001

5. **Generalized Charts for Third-Order Type-1 Systems.** **V. Seshadri,** *Associate Member.*

In this paper, several charts have been developed based on an algebraic formulation of the relative-stability analysis of third-order systems, for application to the analysis and synthesis of third-order type-1 systems in general in both the real and complex frequency domains. The construction and use of the various charts are also explained.

INSTITUTION NEWS

Bilateral agreement with the American Society of Civil Engineers

The bilateral agreement between the Institution and the American Society of Civil Engineers announced in the *Bulletin* (vol. 16, no. 8, April 1967, p. 32) has now been signed. The Memorandum of Agreement on Exchange of Membership Guest Privileges is reproduced below for information of members.

MEMORANDUM OF AGREEMENT
ON
EXCHANGE OF MEMBERSHIP GUEST PRIVILEGES

1. This memorandum records the mutual argeement of the Institution of Engineers (India) and the American Society of Civil Engineers to implement the objectives and philosophy of the statement entitled "International Relationships in Engineering", which is attached and made a part hereof. The agreement is based upon the premise that an engineer practising outside his own country is best served professionally by the national engineering society in the country in which he is engaged, to the end that he becomes a welcome addition to the professional community of that country.

2. In furtherance of this aim it is agreed that a member in good standing of either Society, who is living or working in the country served by the other Society, and who is provided with an appropriate letter of introduction by the Secretary of his own Society, may, if he desires, subscribe to certain guest privileges to be extended by the other, or Host Society. The guest privileges to be made available by the Host Society shall include the following:

(a) A wallet card indentifying the member as a guest of the Host Society for assistance in professional contacts, visits, etc.

(b) Registration in special Foreign Engineer Guest mailing lists to be maintained by the Host Society and any of its local sections in which the guest member might locate

(c) Regular mailings of notices of all technical and social meetings of the Host Society, National or local, with the privilege to attend and participate at regular membership registration fees.

(d) A subscription to the periodical, magazine or newsletter of the Host Society.

(e) Privilege to purchase or subscribe to any publications of the Host Society at the same discounted rates extended to its own members.

3. Upon presentation of his letter of introduction to the Secretary of the Host Society, either in person or in writing, the Foreign Engineer Guest will be extended the privileges above listed upon payment to the Host Society of an annual subscription fee in the amount of $5.00 (U.S). Such subscription fee shall be payable annually in advance for the term of guest enrollment.

4. Foreign Engineer Guest enrolment under this agreement will be extended to any member for a period of not less than one year or more than three years Such enrolment shall be suspended immediately (a) when the Host Society is notified that a Guest Engineer is no longer a member in good standing of his own Society, or (b) when the Foreign Engineer leaves the country of the Host Society.

5. This agreement may be terminated by either Society upon thirty days written notice to the other Society. In the event of termination, all current Guest Engineer enrolments will be continued to expiration.

Suggested Format of Foreign Engineer Guest Identification Card

(To be Wallet Size, Approx. 2½″ × 3½″)

(Front)

PROFESSIONAL PASSPORT

Issued by The American Society of Civil Engineers
to Foreign Engineer Guest

A Member of the

Expiration Date   Signature of Foreign Engineer Guest

(Reverse)

THE BEARER OF THIS CARD

is an official Guest of the American Society of Civil Engineers, entitled to certain privileges that are detailed in a Formal Agreement between ASCE and his own national engineering society. Members of ASCE are urged to extend every possible professional courtesy to this Foreign Engineer Guest to assist him in becoming a part of the civil engineering profession in the United States of America.

Sd. William H. Wisely
Executive Secretary, ASCE

Three-Day Lecture Meeting on 'Transportation Planning', Bangalore, June 15-17, 1967

Under the joint auspices of the Mysore Centre of the Institution of Engineers (India), Bangalore, and the Extension Department of the Bangalore University, a three-day special lecture on 'Transportation Planning' will be held at the Institution Building in Bangalore from June 15-17, 1967. Prof. V. S. Pendakur, Associate Professor in the University of Columbia, will deliver the lectures dealing with the topics such as Metropolitan Problem and Analytical Tools in Traffic Planning; Regional Transportation and Regional Development and Regional Highway Systems, Interchanges and Bypasses; Advanced Analysis in Forecasting and Transport Technology and Transport Environment.

Further details can be obtained from Shri S. G. Ramachandra (M.), Honorary Secretary, The Institution of Engineers (India), Mysore Centre, 3 Vidhana Veedhi, Bangalore-1.

International Formulation of the Thermodynamic Properties of Water and Steam for Industrial Calculations by Computer

The International Formulation Committee, established in 1963 in New York by the International Conference on the 'Properties of Steam', has now published a formulation of the thermodynamic properties of water and steam for use in industrial calculations by computer. This formulation has been agreed upon by the delegations of Czechoslovakia, Federal Republic of Germany, United Kingdom, Japan, the U.S.A. and the U.S.S.R. The formulations cover the ranges from 0 to 800°C. with pressures up to 1,000 bars. The text is in the English language. The document is obtainable from the VDI-Fachgruppe Energietechink, Dusseldorf 1 (Germany), Postfach 1139, on payment of D.M. 48 (U.S. $12).

The document is delivered with the following accompanying documents. a supplement (containing formulae for the specific isobaric heat capacity of ordinary water substance) and tables with thermodynamic property values of ordinary water substance calculated from the new formulation. (This document has been prepared by the U.S. Delegation and it also contains a statement on tolerances.) A sheet with a number of property values calculated at selected state points for testing the computer programme is also attached.

Publications Wanted

The following books, since out of print, depicting the life of ancient India are required for accession to the Indigenous Technical Museum at Nagpur. Members who may have these in their possession and like to donate them to the museum may kindly write to Shri Brijmohan Lal, Adviser, Hindi Section, The Institution of Engineers (India), 3/17 East Patel Nagar, New Delhi 8.

1. 'History of Aryan Rule in Ancient India' by E. B. Havell, *George Harrap*, London.
2. 'Ancient and Medieval Architecture of India: a Study of Indo-Aryan Civilization' by E. B. Havell. *John Murray*, London, 1915.
3. 'Town Planning in Ancient Deccan' by C. P. Venkatarama Iyer of Madras University, *Law Printing House*. Madras, 1916.
4. 'The Tamils Eighteen Hundred Years Ago' by V. Kanakasabhai Pillai. *Higginbotham & Co.*, Madras and Bangalore, 1904.
5. 'Ancient Town Planning' by F. Haverfield. *Clarendon Press*, 1913.
6. 'History of Indian and Eastern Architecture' by James Fergusson. *John Murray*, London, 1876; 2nd edition, 1910.
7. 'Town Planning in Ancient India' by B. B. Dutta. *Thacker Spink & Co. Ltd.*, Calcutta, 1925.

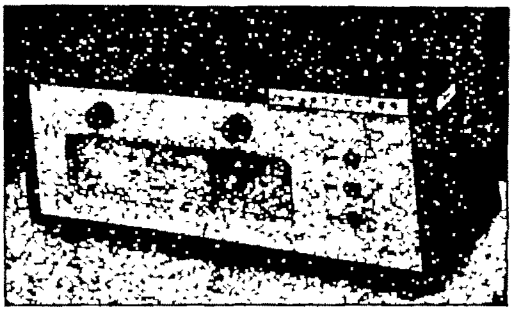
Members are also informed that no copies of Vols. 2 and 4 of the *Journal* are left in the Headquarters Office of the Institution. If these are available with any member he is requested to inform the Secretary at the Headquarters Office.

Water Resources Development Training Centre, University of Roorkee

The 12th Course in Water Resources Development will be commencing on July 1, 1967. This is a twelve-month course designed to enable engineers already in service to acquire advanced theoretical and practical knowledge for development of water resources and design and construction of hydraulic structures connected with river valley schemes. Bachelor's degree holders in Civil, Electrical or Mechanical Engineering with three years professional experience are eligible for admission. For full particulars please write to the Professor and Head of the Water Resources Development Training Centre, University of Roorkee, Roorkee, U.P.

'Burgotector'

The invention of an original device to function as a burglar alarm by Shri Harbans Raj (*Affiliate Member*) was reported in the *Bulletin* (vol. 14, no. 10, June 1965, p. 20). Shri Harbans Raj has now modified the burglar alarm and has named the new device as 'Burgotector'. If any intruder tries to get in through the protected doors or windows, the Burgotector will produce a loud noise and the lights connected with it will glow immediately and will continue to burn. This instrument can be used to protect property from theft, human life from intruders and protection of house from fire. A photograph of the equipment is given here and enquiries addressed to this office will be forwarded to the member.



FORTHCOMING EVENTS

37th Annual Research Session of the Central Board of Irrigation and Power, Bhubaneswar, June 12-18, 1967

The 37th Annual Research Session of the Central Board of Irrigation and Power will be held at Bhubaneswar from June 12-18, 1967. To be inaugurated by Dr. A. N. Khosla, Governor of Orissa, the meeting will discuss papers on the following topics: (i) Hydraulics, (ii) Power, (iii) Concrete and Structural Engineering, and (iv) Soil Mechanics and Foundation Engineering.

Further details can be obtained from Shri R. C. Patra, Additional Chief Engineer (Irrigation), Kesrinagar, Bhubaneswar, Orissa.

Symposium on 'Construction Costs', Delhi, August 1967

A symposium on 'Construction Costs' (organized by the National Buildings Organization, Government of India) will be held in Delhi in early August 1967. Economy in construction cost can be effected at three crucial stages; namely, planning, design and construction. Economy in the planning stage can be effected by rationalizing space requirement, standardising spans. laying down modules and by restricting the height of walls, glazing, etc., to the bare minimum required to ensure that all functional requirements such as lighting and ventilation are adequately met. Economy at the design stage can be effected by choosing designs in steel, reinforced concrete or prestressd concrete which involves the use of minimum of meterial. It is not often realized that speed is conducive to economy and construction time, can be cut if the various operations involved are analyzed and proper construction activities would benefit by the work study and the application of such advance techniques as CPM and PERT.

In order to focus attention on the various aspects of the scheme of cost reduction in construction the following topics will be dealt with during the symposium:

(i) Effect on construction costs due to advance planning, phasing and continuity of work load.

(ii) Cost reduction through rational architectural planning and structural design.

(iii) Scope of cost reduction through research, standardization, mechanisation and use of new and improved building materials.

(iv) Cost reduction through management control, organization and integration of different stages of construction.

Further details can be obtained from the Director, National Buildings Organization, Nirman Bhavan, Maulana Azad Road, New Delhi.

Conference on 'Water Desalination', Bhavnagar, November 1967

The Central Salt and Marine Chemical Research Institute, Bhavnagar, is organizing a Conference on 'Water Desalination' to be held at Bhavnagar in November 1967. This conference will be held in five Sessions and dealing with each of the following topics:

(i) Evaporation processes based on solar energy utilization, solar energy measurement and application; physical properties of sea water.

(ii) Other evaporation processes for desalination; scale formation and prevention; materials of construction, recovery of chemicals from byproduct concentrate.

(iii) Membrane processes including electrodialysis and reverse osmosis; ion exchange techniques.

(iv) Other processes for desalination; evaporation control and re-use of industrial waste water for conservation of water.

(v) Survey of water resources and economics of desalination processes.

These technical sessions will be followed by a concluding session in which suggestions made in the technical sessions will be reviewed and recommendations of the conference will be formulated.

Those wishing to contribute papers may send the titles and abstracts of their contribution by June 1967 and the full paper by August 1967.

Further details can be obtained from Shri S. D. Gomkale, Convenor, Conference on 'Water Desalination', Central Salt and Marine Chemicals Research Institute, Bhavnagar 2, Gujarat.

Second International Conference of Women Engineers and Scientists, Cambridge, July 1-9, 1967

The Women's Engineering Society, London, is organizing the Second International Conference of Women Engineers and Scientists to be held in Cambridge from July 1-7, 1967. The themes of the Conference are: (i) 'Enough for Every One—the Application of Technology to World Food Problems'; and (ii) 'The Woman Professional Engineer'. Her Majesty Queen Elizabeth the Queen Mother has consented to be Patron of the Conference.

Further details can be obtained from Mrs. Molly Neal, 34 Brookfield Park, London, N.W.5.

Twenty-First International Congress of Pure and Applied Chemistry, Prague, September 4-10, 1967

The 21st International Congress of Pure and Applied Chemistry (IUPAC) will be held in Prague, Czechoslovakia, from September 4-10, 1967. The scientific programme will include three separate sections on (i) Automation in Analytical Chemistry; (ii) Toxicological Chemistry; and (iii) Chemistry of Nucleic Acid Components.

Further information can be obtained from the Organizing Committee, 21st International Congress of Pure and Applied Chemistry, P.O. B 139, Praha 6-Dejvice, Czechoslovakia.

Conference on 'Servocomponents', London, November 21-23, 1967

A conference on 'Servocomponents' will be held at the Institution of Electrical Engineers, London, from November 21-23, 1967. The aim of the Conference is to examine the present state of the art as applied to the design, manufacture, testing and application of servocomponents and to indicate the direction of future developments. The definition of servocomponents will, for the purposes of the Conference, include any sub-unit a predominantly electrical closed loop servo-system.

The scope of the Conference will include: (i) Signal elements—synchros and allied devices, potentiometers, encoders, etc.; (ii) Power control—packaged amplifiers (A.C. and D.C.), thyristor control, etc.; (iii) Output elements—motors and motor generators (A.C. and D.C.), stepping motors, torque motors, etc.; (iv) Coupling components—gear heads, clutches, couplings; (v) Interface components—electro-hydraulic and electro-pneumatic components, etc.; (vi) Materials and processes applicable to servocomponents; (vii) Test equipment and testing; and (viii) Applications and user experience. The Organising Committee invite the submission of contributions for consideration for inclusion in the conference programme.

Further details of the Conference and registration forms will be available a few months before the Conference from the Conference Section, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

International Conference on Masonry Structural Systems, Austin, Texas, November 30-December 2, 1967

An International Conference on 'Masonry Structural Systems' will be held at the University of Texas, Austin, U.S.A. The conference is being planned by a committee of the most knowledgeable architects and engineers from government, education, practice, research and industry in the United States and Canada. The conference is expected to establish the present state of the art in research, education and practice relating to the materials, design, construction and function of masonry structural systems. The conference will provide an international forum for the interdisciplinary exchange between architects and engineers of the best available technology on these structural systems. The conference will deal with the following topics: (i) The Creative Challenge of Masonry; (ii) Materials Science Relevant to Structure; (iii) Structural Performance; (iv) Structural Interaction; (v) Environmental Performance; (vi) Design Methodology; (vii) Case Studies; and (viii) Construction.

Further details can be obtained from Mr. Clayford T. Grimm, Conference Secretary, P.O. Box 1726, Austin, Texas 78767, U.S.A.

International Congress on 'Lightweight Concrete', London, May 13-15, 1968

The Concrete Society, London, supported by the Comite European de Beton (CEB), The Conseil International du Batiment (CIB), the Federation Internationale de la Precontrainte (FIP), and the Reunion Internationale des Laboratories d'Essais et de Recherches sur les Materiaux et les Constructions (RILEM), is arranging an International Congress on Lightweight Concrete' to be held in London from May 13-15, 1968. The broad subjects envisaged for the first two days of the Congress, which will have a practical rather than an academic emphasis, are the properties of lightweight aggregates and fresh concrete in relation to site operations, and in the context of aerated concrete and lightweight aggregate concrete: structural and architectural properties of hardened concrete; codes of practice and regulations; general economics and applications. Technical visits will occupy the last day. The registration fee for the Congress, including a set of the papers in English with summaries in French, German and Russian, will be £25.

The detailed programme of the Congress will be issued later this year and full information will be available from the Secretary, International Congress on Lightweight Concrete, Terminal House, Grosvernor Gardens, London, S.W. 1.

BOOK ACKNOWLEDGMENTS

1. **Fundamentals of Electricity—vol. 1: Basic Principles.** Consumers Power Company. *Addison-Wesley Publishing Co., Inc.*, $5.00, 1956, 80 pages.

This book is written for the student for developing an understanding of the basic electrical fundamentals. The text is divided into the following eight chapters: Electricity, Ohm's Law, Series circuits, Parallel circuits, Power, High and low voltage, Magnetism and Summary (practical applications). A glossary of electrical terms and an alphabetized topic index has been included at the end of the book.

2. **Fundamentals of Electricity—vol. 2: Alternating Current.** Consumers Power Company. *Addison-Wesley Publishing Co., Inc.*, $5.25, 1966, 89 pages.

This book gives detailed information about A.C. electricity. The text is divided into the following seven chapters: Significance of A.C. voltage, Wave form analysis, Inductive reactance, Capacitive reactance, Impedance, A.C. power, and Meters. An alphabetized topic index and a glossary of electrical terms is given at the end of the book.

3. **Progress in Control Engineering—vol. 1.** R. H. Macmillan, T. J. Higgins and P. Naslin (eds.). *Heywood & Co., Ltd.*, London, 63s. 1962, 260 pages.

This book presents a critical review of progress in control engineering. In the text an attempt is made to keep a balance between subjects needing a thorough mathematical analysis and those requiring less rigorous treatment. The contents of this volume are : 'The Place of Digital Computers in Control', 'Time Lag Systems', 'Application of Statistical Methods to Control System Design', 'Frequency Response Methods, Applied to Non-linear Systems', 'The Human Operator in Control Instrumentation', 'The Governing of Diesel Engines', 'Operational and Transform Techniques' and 'Automatic Control by Pneumatics'.

4. **Progress in Control Engineering—vol. 2.** R. H. Macmillan, T. J. Higgins and P. Naslin (eds.). *Heywood & Co., Ltd.*, 80s. 1964, 292 pages.

In this book, six articles written by experts, are presented on following topics: Topological Approach to System Analysis, Stability Analysis for Linear and Non-Linear Systems using Liapunov's Second Method, The Principles of Computers and their Application in Research, Finite Automata, Process Parameter Estimation, and Disturbance Control and the Principles of Invariance.

5. **Nonlinear Differential Equations.** T. V. Davies and E. M. James. *Addison-Wesley Publishing Co., Inc.*, $12.75, 1966, 274 pages.

This book deals with the two methods of solving differential equations. The first is the qualitative or topological approach, and the second the quantitative approach. Using the first, one considers the form of the integral curves of a differential system as a whole. The best-known example of the second method is Poincare's small-parameter method.

6. **Calculus—Part 1.** E. E. Moise. *Addison-Wesley Publishing Co., Inc.*, $6.75, 1966, 498 pages.

This book covers the undergraduate curriculum. The style of treatment is based on the spiral process, motivation, etc. A variety of problems are used for a variety of purposes such as technical problems, theoretical problems, sketching exercises and discovery problems.

7. **Chambres d'équilibre** (in French). M. Hussian Khan. *Spes Lausanne*, Dunod, Paris, 1966, 214 pages.

This book gives the work of the author on mathematical models of hydro-electric projects for water-hammer and surge studies with aid of digital computers and its practical applications. The object of the study was to establish with the help of a digital computer, a mathematical model of a hydro-electric project consisting of a reservoir, a tunnel, a surge tank of any type connected to the tunnel by a conduit, a penstock and a turbine of any type. This model is based on non-linear water-hammer equations, which takes into account the kinetic energy of water and the variation of its modulus of elasticity with pressure.

8. **Designs for Modern Living.** Published by the Concrete Association of India, Bombay, Rs. 5, 1966, 42 pages.

This book presents the designs made by Indian architects for better living keeping in view the cost, size, and location of the buildings. Besides these, designs of a few apartments for urban living are also given.

9. **Handbook for Ultimate Strength Design of Reinforced Concrete Members.** R. Chandra and S. Sarkar. *Structural Engineering Research Centre,* Roorkee, Rs. 25, 1966, 169 pages.

This handbook gives design charts based on the recommendations of IS 456-64 for ready use by the designers. It contains 70 full page design charts and 40 tables computed by using a digital computer along with exhaustive treatment of the design approach. Metric units have been used and charts prepared for mild steel (Grade I-IS-432-1960) and medium tensile steel (IS : 432-1960). The analysis can be easily extended for other qualities of steel.

10. **Fundamental Hydraulics—vol. I.** V. B. Priyani. 3rd edition, *Charotar Book Stall,* Anand, Rs. 12.50, 1966, 393 pages.

This third revised edition of the book gives new material on Reciprocating Pumps, Special Pumping Devices and Hydraulic Machines. Only metric system of units has been used in this book. The text is illustrated with diagrams and numerous solved problems along with answers have been included.

11. **Engineering Mechanics.** S. B. Junnarkar. *Charotar Book Stall,* Anand, Rs. 7.50, 1966, 300 pages.

This book gives a lucid presentation of the subject with sketches, solved examples, making use of British and Metric units. Use of calculus is avoided in the text. The book is meant for help to students of diploma courses.

12. **Engineering Drawing.** P. N. Vikayvergiya. *New Asian Publishers,* Delhi, Rs. 12.50, 1966, 330 pages.

In this book are dealt the fundamental principles of plane and solid geometry, machine drawing and also building drawing. The text is illustrated by illustrative drawings to enable easy grasp of basic concepts. The graded chapters at the end of each chapter will help the readers.

13. **Road Engineering.** V. B. Priyani. *Charotar Book Stall,* Anand, Rs. 10, 6th edition, 1966, 326 pages.

This revised sixth edition of the book includes an additional chapter on 'Road Research'. Metric system has been used side by side with F.P.S. system of units. The text is fully illustrated with diagrams.

14. **Mechanical Technology.** L. B. Pandya. *Charotar Book Stall,* Anand, Rs. 6.75, 1966, 238 pages.

This book deals with topics on materials of construction, timber, various kinds of joints, and hand tools used in pattern-making shop, foundry, fitting, smithy shop, etc. Fundamentals of processes such as heat treatment, soldering, brazing, and welding are given. Instruments of measurement have also been briefly described. The book is meant for degree and diploma students of engineering.

15. **Engineering Metallurgy.** S. P. Nayak. *Charotar Book Stall,* Anand, Rs. 15.00, 1966, 533 pages.

This text deals with the properties of metals as applicable to engineering materials and the application of metallurgy to workshop technology. Tables giving design data are provided. Both the metric and the F.P.S. system of units have been used in the book.

16. **Worked Examples in Alternating Current for Engineering Students.** P. J. Freeman. *Asia Publishing House*, Rs. 7.50, 1966, 108 pages.

In this book the basic principles of alternating current are dealt through eighty-four worked examples and thirty-four diagrams. It deals with basic single and three-phase circuit theory, power-factor correction, the single phase transformer and the three-phase induction motor. The solutions given involve the simpler mathematical processes, symbolic notation being purposely excluded.

17. **Principles of Steelmaking.** Dr.-Ing. A. K. Biswas. *Asia Publishing House*, Rs. 25, 1966, 412 pages.

In this book are dealt the important steps in the process of steel-making such as the removal of various elements like carbon, silicon, manganese, phosphorous, sulphur, hydrogen and nitrogen. The study of the various phase-systems is stressed. Surveys of chemical interaction of various components and that of the nature of steel making slags have been made. The book will be of help to students of graduate and postgraduate courses, steel makers, teachers and research workers.

ADDENDUM

TO VOL. 16, NO. 7. MARCH 1967

Page 78, please read the address of the publisher of the book in item 15, 'Engineer's Reference Book', as G. C. Tolaney, TCX-S-19, Gandhidham (Kutch).

PUBLICATIONS RECEIVED

A copy of a reprint of a paper entitled 'Human Relations in Industry' by M. Ahmed has been received from the Rajasthan Centre of the Institution. The article was published in the Sixth Annual Number of the Rajastan Centre.

A copy of the 'Journal of the Institution of Engineers (India)—Poona Centre' has been received from the Poona Centre of the Institution. This publication contains nine papers read at the Eighth Annual General Meeting of the Centre.

A copy each of the 'Technical Bulletin' dated September 1966 and December 1966, issued by the Technical Club and the Neyveli Sub-Centre of the Institution has been received.

A cyclostyled copy of a 'Report of the Work and Activity for the period August 1965 to September 1966' has been received from the Technical Information Centre for Chemical Industry, Bombay.

A copy of a publication entitled 'Aanceb', published by the Bombay Branch of the Alumini Association, Jadavpur University, has been received.

A copy of the Annual Report of the Chief Inspector of Mines has been received from the Office of the Chief Inspector of Mines, Dhanbad. This report covers the year ending December 1964 and deals with the employment and labour situation in the mining industry, output and mining conditions, accidents, administration of the Mines Act, safety in mines, and related topics.

A copy of the first issue of a periodical entitled 'Journal of Engineering Geology' has been received from the Indian Society of Engineering Geology, Calcutta.

A copy of the 'Annual Bulletin 1966' of the International Commission on Irrigation and Drainage has been received from the Commission's office in New Delhi.

A copy of a publication entitled 'Evaluation of the Benefits of the Nizamsagar Irrigation Project' has been received from the Research Programme Committee of the Planning Commission, Government of India, New Delhi. This report contains the survey undertaken by the Department of Economics of the Osmania University, druing 1960-61, pertaining to the benefits of the Nizamsagar Irrigation Project.

A copy of a publication entitled 'Nagarjunasagar' has been received from the Nagarjunasagar Dam Project, Nalgonda District, Andhra Pradesh. This publication gives the salient features of the dam and its canals and the archaeological excavations.

A copy of 'Annual Report 1965' has been received from the Technical Laboratory, Central Research Institute of Electric Power Industry, Tokyo. This report reviews the recent principal research activities of the laboratory whose object is to carry out experiments, investigations and researches serviceable to the solution of specific problems of the owners of electric power facilities.

A copy of a publication entitled 'Power Reactor Characteristics' has been received from the European Nuclear Energy Agency of the Organisation for Economic Co-operation and Development, Paris. This publication contains reports on (i) graphite-moderated, gas-cooled reactors, (ii) light-water reactors, (iii) heavy-water reactors, (iv) fast reactors, (v) liquid-fuel reactors, and (vi) summary of data for various reactor types.

A copy of a publication entitled 'Rapid Analysis of Alloys—Spectrometric Techniques' has been received from the Public Relations Office of Falconbridge Nickel Mines Ltd., Toronto, Canada. This publication describes the usefulness of spectrometry in a modern foundry or a melting shop.

PERSONALS

SHRI G. S. MARWAHA, M.I.E., Regional Inspector of Mines, Special Investigation Duties, Government of India, has been invited by the Council of the Institution of Mining Engineers, London, to become the Institution's Member of Council for India. He is the first Indian to be accorded this honour, his immediate predecessor (1954-67) being Dr. J. W. Whitaker, M.I.E., a past Chairman of the Mining and Metallurgy Division Board of the Institution of Engineers (India). Shri G. S. Marwaha was also a co-opted Member of the Mining and Metallurgy Division and a Past Chairman of the Dhanbad Sub-Centre of the Institution.

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here.

Shri G. P. Roy

Shri Goloke Prasad Roy, B.E., M.I.E., died on March 15, 1967, at the age of 77. He was a Life Member of the Institution.

Born at Rameswarpur, Balasore District, Shri Roy passed the Intermediate Science degree examination in 1910 and the B.E. degree examination of the Calcutta University in 1917. He had his apprenticeship training at the Gorumahisani mines of the Tata Iron and Steel Works. Subsequently, he worked as Supervisor in the Puri District Board during 1918-20, and as Assistant Engineer in Martin & Co., Calcutta, during 1920-23. In 1923 he was appointed as District Engineer, Puri, in which post he continued till his retirement. Shri Roy was responsible for the construction of many buildings and roads in the Puri District of Orissa.

Shri Roy joined the Institution as Member in 1937.

Shri B. N. Khanna

Shri Badri Narain Khanna, B.A., B.Sc. (Engg.), A.M.I.E., died in January 1967 at the age of 57.

Born in 1910, Shri Khanna attended St. Stephen's College, Delhi, and passed the B.A. examination of the Delhi University in 1930. He then proceeded to the U.K. and obtained his B.Sc. (Hons.) degree in Civil Engineering from the University of Leeds in 1932. He joined Bird & Co. in 1933 and continued till 1942 when he joined the Department of Supply, Government of India. He was posted at the Indian Supply Mission, Washington, as Deputy Director of Supplies from 1956 to 1960. On his return to India, he became Director in the D. G. S. & D. in which post he remained till his death.

Shri Khanna joined the Institution as Associate Member in 1947.

Editor's Note

The passing of Shri N. C. Sen, B.E.E., M.I.E., Works Manager, Bengal Electric Lamp Works Ltd., has been reported in the *Bulletin* (vol. 16, no. 7, March 1967, p. 81). The photograph of Shri Sen which did not reach in time, is given here.

EMPLOYMENT SERVICE

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ENERGETIC & INTELLIGENT RESEARCH WORKER, aged 32 years, possessing B.Sc. degree in Physics, Chemistry and Mathematics from Gauhati University and passed sections A and B (both in new scheme) of A.M.I.E. Civil, (India) examination with soil mechanics and foundation engineering and water power engineering as optional subjects, having 8 years experience in studying the sediment role in determining the river behaviours on the basis of hydrological observations and laboratory tests, various laboratory tests for determining the engineering properties of soils, and 4 years experience in construction of mathematical models of rivers and estuarine channels, stability analysis of earth dams and breakwaters, wave form analysis, scour pattern around a coffer dam, analysis of problems with the help of Electronic Digital Computer; desires suitable immediate employment in semi-Government, Government or private concern, reasonable salary acceptable. (Office ref. E.S. 286).

WORKS MANAGER of a public limited industry outside Calcutta, B.E. (Mechanical), A.M.I.E. (India), aged 33, with present responsibility over factory and also commercial sides, sales, etc., with brilliant professional achievement, about eight years' thorough experience in machineshop/tool room, production control, administration in the position of Senior Executive in an international British firm and works manager of medium manufacturing industry and an industrial training abroad; seeks change to similar position in a progressive industry in/around Calcutta. Interested to take complete charge of the works and commercial sides or works of a medium/heavy industry as Works/General Manager. Also may change to the position of a Senior/Chief Executive/Departmental Manager of a British/European industry. Emoluments around Rs. 2,000.00 per month, transport, perquisites. (Office ref. E.S. 287).

INSTRUMENT TECHNICIAN, age 27, good sportsman, intelligent, ambitious, a student member of the Institution of Engineers (India) with handsome personality and active habits; having 9 years of colour service in the Indian Air Force in different capacities. Present total consolidated emoluments Rs. 550 per month; seeks immediate change in Instrument Engineering/General Engineering/Aeronautical Engineering/Sales/Administrative/Security/Instructional job. (Office ref. E.S. 288).

YOUNG ENGINEER, Grad. I.E., passed L.E.E. in the third rank in Mysore State, with three years experience in operation and maintenance of all types of heavy electrical machines with their controls used for the operation of rolling mills in a large steel making concern, seeks change in a well established private firm; employment in South India preferred. (Office ref. E.S. 289).

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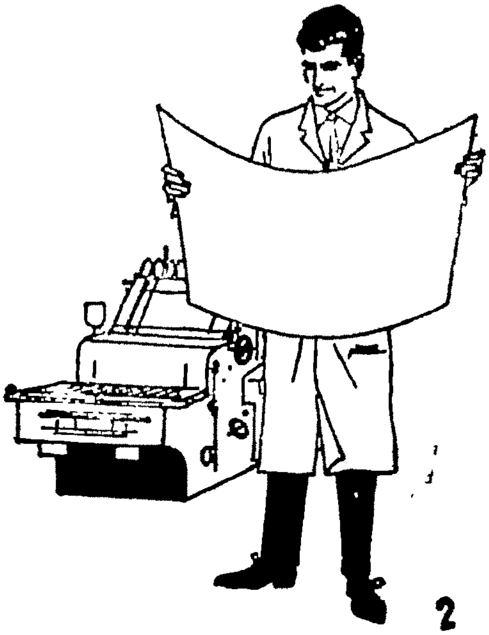

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THE BULLETIN

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EXPO 67 CONSTRUCTION*

Colonel E. Churchill

Non-member

Introduction

In some respects, the Universal and International Exhibition of 1967, being held in Montreal from April 28 to October 27, 1967, presented challenges of greater diversity and scope than those usually associated with the compressed schedules and special constructions in World Exhibitions. These special challenges arose because of the extraordinarily short time of three-and-a-half years available to the planners, designers and construction forces to initiate and complete the planning, design and construction of EXPO 67. Ordinarily, world Exhibitions have been initiated in something like four-and-a-half years to nine years ahead of the event.

The decision to request the Bureau of International Exhibitions for approval to hold a World Exhibition in Canada, was taken by the Federal Government. This Government, with the Province of Quebec and the City of Montreal, jointly financed the expenditures for the work on the site in the percentages of 50%, 37½% and 12½% respectively. The three levels of Government agreed to entrust the execution of the work to the Canadian Corporation for the 1967 World Exhibition, a Crown Corporation with responsibilities and authorities outlined in an Act establishing the company.

Successful companies and technical organizations need time for the selection of personnel, the development of an organizational structure, the development of the important and intricate relationships between the various levels in the organization and the development of a team in the fullest interpretation of the word. People, after all, are the basis of any human undertaking and endeavour. Canadians can be justly proud that the many hundreds of different kinds of skills needed were put together in a fully effective organization in the time available. The enthusiasm of the staff and the dedication to the goals that the Corporation sought to achieve has been truly remarkable.

The limiting time factor was escalated by other features of the Exhibition. The decision to create an exciting and visually dynamic site in the middle of the St. Lawrence River created special problems of access and construction timing. In the event, the islands were ready for construction activity to begin only on July 1, 1964. The time compression to be faced was even more serious when the planners took into account the special impact of Canada's Centennial on the planning and the remarkable participation by foreign Governments. The EXPO authorities therefore embarked on a very large construction programme on a virgin site with made ground and in addition, obtained Government approval to construct many special pavilions. These pavilions, the Theme Pavilions which accommodate the Theme Exhibits, were a vast and difficult undertaking in Canada where these special skills were only in an embryonic state.

---

* By courtesy of the Canadian Corporation for the 1967 World Exhibition, Place Ville-Marie, Montreal.

Some principles which, although they have proven to be successful, nevertheless created special problems in the time frame available. From the very beginning, the EXPO planners were determined that the aesthetics of the site and in fact all matters concerning EXPO 67, would be under careful review by a specially created Aesthetics Committee. This meant that every object, whether it be designed by the Corporation or designed by a concessionaire, would require the prior approval of this Committee.

Special attention was also paid to orientation problems on the site and the need to give unification and coherence to the various parts of the exposition. These matters were of some concern because it was established very early in the planning that the keynotes of visitor handling would be the comfort and welcome to the visitor. Thus, a reservation system to minimize time in queues and the troubadour vans which will be dispatched to queue lines to entertain people in queues, the liberal number of information kiosks and the information display boards to give immediate programme notes to site visitors, are all part of the attempt to give special care to the visitor.

Of course, perhaps the greatest single unifying philosophy behind the EXPO was a sincere dedication to the theme 'Man and His World'. As a result of this theme and its interpretation by EXPO officials, it was clear that the physical layout of the site would be very much affected. The Theme Pavilions were initially conceived to link the various parts of the Exhibition together and give visual unity, a problem apparently faced in previous World Exhibitions without too much success.

Further, it was decided to locate participants' lots without regard to political or economic power. Thus, pavilions which could be expected to draw large crowds were put at the extremities of the layout so that other pavilions would be in the path of visitors travelling between such poles of interest.

It might be said that EXPO is the first really large and complex construction project that has used computer oriented management techniques on a mandatory basis for all architects, engineers and contractors. The Critical Path Method, which was perhaps not too well known in 1963, is now a tool in the general knowledge of most engineers and contractors. Perhaps this could be ascribed to the intensive use of this technique at EXPO 67.

Site work

Logically, there were some projects which required very early action. These, generally, were projects which improved site access and which had long lead and construction times. These were the bridges across the St. Lawrence River connecting Harbour City (formerly MacKay Pier) and the island of St. Helene, and across the Lemoyne Channel connecting Ile Notre-Dame and Ile St. Helene. The importance of these access routes to the islands cannot be over-stressed. World Exhibition sites have had as many as thirty access points and generally never less than seven entrances. EXPO 67 was faced with three entrances and, therefore, the importance of the construction of the bridges to permit full-scale construction activities as early as possible was a 'must'. This meant that the alignment of the transportation systems and the road network, as well as a lot plan layout had to be developed at top speed so that the alignment of the bridges could be determined. Borings were taken during the first two weeks in December 1963 and this permitted the design, which began in the first week of December, to be put in hand. The Concordia Bridge, across the St. Lawrence River, was therefore, awarded in March 1964. The bridge is an orthotropic bridge which permitted the construction to go on at full scale during the winter and, as a result, the bridge was ready for traffic in June 1965.

During this period, it was necessary also to establish the final contours of Harbour City and the enlargement of this former breakwater took place during the whole of 1964. The whole question of dirt moving was given intensive study and it was decided to undertake the trenching for buried services, the construction of canals and the base course for roads as early as possible. So, in the main, these works would be completed before the beginning of the construction of pavilion foundations. Elsewhere, the statistics and description of the high voltage power distribution system, water, sewers, roads and gas distribution system will be found. Perhaps one civil works project deserves special mention. The site has two sewage treatment plants, one on the island of Ile Notre-Dame and the other at the parking lot near the Victoria Bridge. These sewage treatment plants are important because they are the first two secondary treatment plants of any consequence in the Province and their importance in these days of concern about the pollution of our waterways is evident.

The creation of new ground meant that the services had to be designed and constructed, as well as the landscaping and the beautification of the site. Therefore, early in 1964, a contract was awarded for the growing of some 200 odd acres of grass. The sod specified was a little thicker than usual so that a good 'catch' would be obtained and this programme has been most successful. Almost all of the grassed areas were completed before the first snow in 1966.

Because of the timing, it was decided that the roads would be built and landscaping installed as early as possible and the inevitable damage accepted. Fortunately, the repairs were not too heavy.

Buildings and structures

There is literature available to describe many of the pavilions at EXPO. Perhaps it can be seen that the principles which the planners sought have been achieved in the buildings and structures. World exhibitions have traditionally been fallow ground for new architectural and engineering projects. It was determined that the shapes of buildings and structures would be attractive, interesting and exciting and the use of new materials, new methods, new construction and architectural concepts encouraged.

The use of timber in very large laminated beams can be seen in the 'Man in the Community' complex, at the Place des Nations and in the Pedestrian Bridge (Cosmos Walk) across the Lemoyne Channel. These large beams are an interesting use of a traditional Canadian construction material.

The space frame concept was thoroughly explored in the construction of the Theme Pavilions on Ile Notre-Dame and on Ile St. Helene. The use of assembly line techniques was evident in the concrete construction in Habitat '67.

Unconventional methods used in the preparation of contract 'packages' and compression of schedules could be seen in the construction of the warehouse underneath the Jacques Cartier Bridge. This warehouse was started in November 1966 and was completed at the end of January 1967. The value of the project was approximately $3,75,000.

Throughout the construction of the Corporation's buildings and structures, all materials in short supply with long lead times or those items which were produced in cycles, were identified on the Critical Path Networks and pre-purchased before the tender call for the general contract. This pre-purchasing of material had some startling effects. It meant that the contractor, in many cases, could be in full-fledged activity within a week of award, with the materials he required on hand. Generally, there was no hold-up for steel, transformers, switchgear, pumps, motors and the like. Thus, the Administration Pavilion, a $5 million permanent structure of 210,000 sq. ft. was started in September 1965 and completed in mid-April 1966.

Conclusion

No other project where young professionals had so great an opportunity to gain experience in so short a time by witnessing so many different kinds of approaches and solutions to engineering and construction problems is known to the author.

This improvement in the technical experience of professionals was not restricted to the office. Field engineers and foremen, in many cases also relatively inexperienced and young, were also the recipients of an accelerated period of learning. This was also true in the case of industrial designers and fabricators for the exhibits in pavilions. One might say that in this field, the Exhibition created the beginnings of a lively new profession and industry. Perhaps it is not known too broadly that a tremendous scientific input from the academic community was required to develop exhibits. The Advisory Committees in these fields not only assisted the Corporation in developing the concept of the Theme Exhibits but were also intimately engaged in monitoring the preparation of exhibit designers' plans to ensure scientific integrity.

This has been a brief outline of some aspects of EXPO 67. It is, of course, not complete. Nevertheless, the author can state categorically, that the experience gained by Canadians in preparing and mounting a World Exhibition of the character and scope of EXPO 67 in the time compression with which we were faced, has already had a decided effect on the assessment of Canadian technology in the eyes of users beyond the country's borders. The opportunity has been created. It is now only necessary to capitalize on the goodwill that EXPO has developed in countries all over the world and seize the opportunity to export Canadian technological skills and know-how.

COST COMPARISON OF LIGHTWEIGHT *vs.* NORMAL WEIGHT PRESTRESSED CONCRETE

As indicated in the report on the 5th Congress of the Federation Internationale de la Precontrainte (F.I.P.), published in the Institution *Bulletin* for October-November 1966, this international organization has several technical commissions investigating various aspects of prestressed concrete. One such commission is that on Prestressed Lightweight Concrete. A communication has been received from the Chairman of this Commission, Mr. Ben C. Gerwick, in which he has forwarded a comparison between lightweight and normal weight prestressed concrete made by Mr. Frank Erskine. Members are requested to send the results of their experience to the Institution to enable Shri K. F. Antia (M.), a member of this Commission, forward a suitable note to the F.I.P.

Although the comparison given below is between lightweight and normal weight prestressed concrete, it will be appreciated that this type of concrete competes with structural steel and other building materials. Because of the weight reduction, lightweight concrete permits concrete to compete successfully with steel in many cases where heavier concrete might be uneconomical. Experience on this and any other aspect may be included by members in their comments.

'Cost Comparison of Lightweight *vs.* Normal Weight Prestressed Concrete'

by F. Erskine

We have selected two types of structures to illustrate cost comparisons of lightweight and normal weight concrete. The first example is a gymnasium and the other a parking garage.

For clarification, by gymnasium I mean a building for sports activity, requiring a fairly large column-free floor area. Our example is 100 ft. × 120 ft. —approximately 30.5 m. × 36.6 m. Cast in place columns 20 ft. (6.1 m.) high with cast in place beams spanning 24 ft. (7.3 m.) support the post-tensioned tee roof spanning 100 ft. (30.5 m.).

The cost analysis considers the tees, columns, beams, footings as well as transportation and erection of the tees.

The tees are precast post-tensioned elements 8 ft. (2.4 m.) wide and 3 ft. (0.9 m.) deep.

For the comparison we will relate costs to the normal weight concrete costs.

Both the lightweight and normal weight tees are of the same size, consequently requiring the same volume of concrete. Because of the more than 25% weight reduction, less steel is required.

Similar steel costs savings are reflected in the columns and beams. In the footings the reduced load results in savings in both concrete and steel. No cost savings are realized in transportation but in erection we can save about 40%

Summarizing we find the lightweight costs 86% of the normal weight design, or saves 11 cents per sq. ft.

The second example is a parking garage with post-tensioned tees spanning 60 ft. (18.6 m.).

Fire resistance is a consideration in this design. For a 3-hour rating the normal weight slab must be 1 in. (2.54 cm.) deeper and the stem a bit heavier. Both tees are 4 ft. (1.25 m) wide.

Because the lightweight tee requires less concrete which reflects in some additional weight reductions, the total concrete cost for the lightweight design is less than the normal weight in this case. Also in this example we realize a saving in transportation.

Summarizing, the lightweight design offers approximately a 30% cost saving over the normal weight concrete, or 33 cents a sq. ft. of parking area

Symposium on 'Modern Electronic Communication Technique', Hyderabad, August 1967

The 450th Meeting of the Council will be held in Hyderabad during last week of August 1967 and the Andhra Pradesh Centre is organising a Seminar on 'Modern Electronic Communication Technique' to be held concurrently during the Council Meeting.

This Symposium is second in the series to be held at the instance of the President, Maj. Gen. S. P. Vohra, during the Council Meeting.

The first Symposium was held at Srinagar from May 26-28, 1967, on the subject 'Roads and National Highways'.

Further details can be obtained from the Chairman, Andhra Pradesh Centre, The Institution of Engineers (India), Khairatabad, Hyderabad 4.

CORRIGENDA

TO VOL. 16, NO. 9, MAY 1967

Page 4, please read the name of the Chairman of the Bombay Centre as 'Maj. R. P. E. Vazifdar', add the name of the Honorary Secretary 'P. G. Patankar', and read the name of the Member of Committee as 'R. N. Vinekar' instead of 'R. V. Virekar'.

CORRIGENDUM

TO VOL. 16, NO. 10, JUNE 1967

Page 34, line 38, please read 'April 6, 1967', instead of 'April 6, 1947'.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Delhi Centre

Chairman's address by Shri G. K. Chandiramani, B.E., M.I.E., at the 40th Annual General Meeting of the Centre on February 12, 1967

After welcoming the Chief Guest, Dr. Zakir Hussain, the then Vice-President of India, and other invitees, Shri Chandiramani thanked the Committee of the Centre for electing him Chairman for the ensuing year.

Delivering his Chairman's address, Shri Chandiramani said:

I am grateful to my colleagues on the Executive Committee of the Delhi Centre for having elected me Chairman for the coming year. Having spent the best part of my working life in Technical Education, first as a teacher in an engineering college for 10 years and later in the Ministry of Education for almost 21 years, I regard my election as an acknowledgement, on the part of my brother engineers, of the importance of the role of Technical Education in the advancement of the profession. I deeply appreciate the honour and I only hope that I shall be able to maintain the excellent traditions of the Centre and the high standards set by my predecessors.

The Institution of Engineers (India) is the oldest professional body in the country and the only one which embraces all branches of engineering. It was started in 1921 as a society and in 1935 it was granted a Charter.

The Institution has rendered useful service in providing a forum for information and exchange of ideas. Its membership today is over 56,000 out of which over 13,000 are Corporate Members. The technical activities of the Institution are carried out through seven Divisions and ten Groups. The seven Divisions are: Civil Engineering, Electrical Engineering, Electronics and Telecommunication Engineering, Mechanical Engineering, Chemical Engineering, Mining and Metallurgy, and Public Health Engineering. The ten Groups cater for Aeronautical Engineering, Automatic Control, Industrial Engineering, Marine Engineering and Ship Building, Nuclear Engineering, Petroleum Engineering, Prestressed Concrete Engineering, Railway Engineering, Roads and Road Transportation, and Shell Structures.

The growth of the Institution necessitated the decentralization of activities resulting in the setting up of a number of Local Centres. The needs of the large number of members so widely dispersed and of varied interests are thus catered for.

The Delhi Centre of the Institution was started in 1927, but it was then known as the North-West India Centre and later as Central India Centre as it covered certain other parts of the country also. In 1944, the Centre had a membership of 121. Today, it has crossed the figure of 6,000.

There has been sustained interest shown by members of the Centre in technical meetings and other activities and it is indeed gratifying to note that with the support received from the parent body, the buildings of the Centre, which were put up in 1952-53, are now being extended to provide the additional facilities badly needed by the Centre. With the extension of the buildings, the Centre will have a fair-sized library which is essential for the fulfilment of the objects of the Institution.

The Student Chapter of the Delhi Centre has been an active one and the Local Centre Committee has established prizes for best technical papers written by Students. A special session of the Students is arranged on the occasion of the Annual Meetings and one such session was held the day before yesterday.

I would now like to avail myself of this opportunity to share with you some of the thoughts concerning the development of technical education in this country and the problems in that field.

Manpower planning

The most vital factor in economic development is the availability of adequately trained manpower at various levels. Unless supply of such manpower in the required numbers is ensured, the progress of developmental projects is bound to suffer. It is equally important that these projects should throw up a sufficient number of jobs to absorb the available manpower and to provide employment in an increasing measure in order that social problems are not created that would lead to frustration and stagnation. This underscores the importance of efficient manpower planning that would strike a proper balance between the supply and demand of properly trained manpower.

It takes 4-5 years to train an engineering graduate and 3 years to train a diploma holder in an institution, but it takes much longer to produce engineers or technicians capable of designing, manufacturing, erecting and operating the various plants. The manpower planner, therefore, needs adequate information well in advance about the development aimed at in the various sectors of economic activity. Only then can he forecast with a reasonable degree of accuracy the demands of trained personnel which would enable the educational planner to do his job namely to provide for adequate institutional facilities in time.

We have had three Five-Year Plans during which we have witnessed at different times acute shortages and sizeable surpluses of trained manpower in certain fields. I recall that soon after the Second Five-Year Plan started, acute shortage of engineering personnel was felt in almost every branch and a committee had to make a quick survey of the situation and suggest methods to fulfil the needs of personnel during the Second Plan period itself. Since then long-term perspective plans in the various spheres of economic activity have been drawn up by our planners, but due to a variety of factors, the targets set become incapable of realization throwing out of gear all manpower calculations and forecasts. Lately, we have also had reports about surpluses of civil engineering graduates. We have also had reports of regional imbalance-surpluses, particularly at the diploma level, in one region of the country and shortages in another. The inevitable conclusion is that the manpower planning machinery needs to be improved and the techniques for forecasting demands need to be refined.

Coordination of technical education

Towards the end of the Second World War in 1944, it was recognised that Technical Education at the post-school stage needs to be planned on an all-India basis. With the consent of the State Governments, the All India Council for Technical Education was set up in 1945, and this Council, which had on it representatives of the State Governments and the Centre along with other interests concerned with Technical Education, was entrusted with the task of coordinating the development in this field.

Planning of technical education on all-India basis and the execution of the various plans to serve the total needs of the country is quite a complex operation. It has to be remembered that according to our Constitution, Education is a State subject. Through the All-India Council for Technical Education, the participation of the State Governments is secured in all policy formulation; the implementation of the policy so formulated is, however, based on the goodwill and understanding established between the individual States and the Centre. Being an advisory body, there are no sanctions attached to the decisions or recommendations of the Council. The arrangement has worked fairly well in the past, but more recently there have been cases where certain authorities have acted in disregard of the advice given by the Council. Technical Education is expensive, and it is therefore a matter for serious consideration as to how best it could be ensured that the limited resources of the country are utilzed to the best advantage of the country.

Growth of technical education

In 1947, there were 38 institutions providing facilities for first degree courses in engineering admitting 3,000 students every year; at the diploma level, there were 43 institutions with an annual intake of 3,700 students. At the end of the Third Five-Year Plan in 1965-66, the number of institutions at the degree level increased to 133 with an annual intake of 24,700 students and those at the diploma level increased to 274 with an intake of 48,000. Likewise, at the post-graduate level, from hardly anything to talk of, provision was made for over 2,000 seats in 41 institutions for a variety of courses and the actual enrolment reached the figure of 1,150.

In terms of the financial provisions made for developmental expenditure, the First Plan provided Rs. 20.2 crores; the Second Rs. 49 crores and the Third Rs. 142 crores. Although, the Fourth Five-Year Plan allocations are not yet finalized, the expectation is that a sum of the order of Rs. 250 crores will be provided for the development of Technical Education.

Problems of rapid expansion

The rate of growth in numbers during the post-Independence period has been tremendous. The rapid growth has naturally affected the average standard as the provision of physical facilities and staffing of the institutions has not kept pace with the growth in numbers. With deliberate action, however, it has been possible to attain high standards of education in some of the institutions, and therefore the country produces today graduates and diploma holders who can compete with the best graduates and diploma holders from anywhere in the world. Yet one cannot take this fact as an index of the total achievement; the average needs to be stepped up considerably.

Mainly on account of the opportunities open to good engineering graduates and diploma holders in industry, etc., the teaching profession has not attracted the best and there is shortage in numbers also. Almost, one-third of the teaching positions are vacant. This has resulted in heavy load on the teaching staff with hardly any time to reflect on matters of importance to the development of Technical Education, such as curriculum development, production of teaching materials and aids, examination reforms, introduction of new teaching methods. What is causing the greatest concern is the fact that not many of the teachers have had a good measure of field experience.

Equipping of laboratories of the institutions, which have grown in such large numbers, has also presented a formidable difficulty and particularly so in the case of degree institutions. Foreign exchange has been scarce and the indigenous production has not been able to take care of the requirements of these laboratories in full. Increasingly more and more is being obtained from indigenous supplies and through arrangements made with foreign countries for assistance in various shapes and forms. But even so, there is a great deal to be done to equip the laboratories well.

Some important measures taken

It is the quality of the teacher that in the final analysis makes for the success of any educational programme. In recognition of this fact certain measures have been taken to provide opportunities to young men to improve their competence for the teaching profession.

The major step has been the intensification of post-graduate activity. The Indian Institute of Science, Bangalore, the oldest science research institute in the country, has, during the last 20 years diversified its activities and introduced many engineering and technological disciplines. Five Indian Institutes of Technology have been established with the object of training high grade technologists and they provide extensive facilities for advanced courses and research. Post-graduate courses have been started in many other established colleges also and in all there are over 40 such centres now functioning in various parts of the country. In accordance with the recommendations made by a committee under the chairmanship of Prof. M. S. Thacker, Member, Planning Commission and a past President of this Institution, new 2-year Master's degree courses providing for a deeper understanding of the scientific principles underlying engineering have been introduced. Every entrant for the post-graduate courses receives a scholarship of Rs. 250 per month for the Master's degree and Rs. 400 per month for the Ph.D. It is believed that quite a proportion of those who obtain post-graduate degrees join the teaching profession.

Programmes for pre-service and in-service training of teachers have also been launched. A teacher-training fellowship programme was initiated in 1950 under which bright young graduates are given a fellowship of the value of Rs. 400 per month for training at selected post-graduate institutions in the country for a period of three years. The programme is tailored to the needs of each trainee who is attached to a senior teacher. The trainee not only gets acquainted with teaching methods but has the opportunity to acquire a Master's degree. He may also get some industrial experience during this period or engage himself in any other pursuit in which he has special interest. After the satisfactory completion of the training period, he is assured of a position as Lecturer in one of the degree institutions in the country.

For the training of teachers for diploma institutions, three regional institutes have been started at Calcutta, Bhopal and Madras, and the fourth is expected to start functioning soon. The programme of training of teachers in these institutes includes a heavy doze of industrial training.

In-service training programmes have been provided in what are called the Summer Institutes which are organized during the vacations. The number of such institutes has been increased progressively and the training programmes have also been improved from year to year. From this year onwards, sequential courses are being organised in these institutes. The idea is that a teacher may undertake such a course in three successive summer vacations and improve his competence in the field with which he is concerned and cover the ground which would normally require attendance for a whole academic session.

Liaison with industry

Involvement of the industry is essential for the success of the various programmes in the field of Technical Education. Only when there is a two-way flow between the institutions and the industry that Technical Education becomes a live instrument for the training of the right type of personnel, be it for the training of engineers or technologists or for the training of technicians. I am sorry to say that the industry in this country, by and large, has not functioned as an active partner in this field. In all advanced countries, there is close liaison between the industry and the technical institutions. The industry plays its part in a variety of ways. It helps the institutions plan courses that would be of use to the industry ; it provides the necessary facilities for the practical training of students; and it affords opportunities to the teaching staff to have an insight into the working of the industry. The industry makes it possible for institutions to run sandwich courses; it provides to its employees and apprentices the opportunity to attend part-time and short-term courses at the institutions. In doing all this, the industry recognizes the advantages that would accrue to it as a result of this cooperation.

I do not wish to apportion blame for the present unhappy situation in this country where there is so little of dialogue between the two parties. It is high time that the engineers in the field and the educators got together and worked out schemes for cooperation which would be to the mutual benefit of both. Perhaps a start could be made with the deputation or secondment of teachers to industry for specified periods. Teachers who have post-graduate degrees—Master's and Ph.D—could be associated with programmes of research, design and development in industry, and polytechnic teachers could work on various aspects of production.

I look forward to the day when there will be such rapport established between the industry and the educational institutions that it will give the industry the necessary confidence to entrust consultative work to teachers for solution of their problems at various levels. Consultation with professors and other teachers in educational institutions for the solution of problems in industry is a normal feature of all developed economies. There is no reason why it should not come about in this country also where large scale industrial development programmes are being implemented.

Content of technical courses

There has been a great deal of debate whether the degree courses should be broad-based or otherwise. Forward looking employers in advanced countries have had no differences with the educators that while the industry needs specialists, the first degree course should not attempt at specialization but that this should come at the post-graduate stage for those who show the necessary ability. It is recognized that there are several advantages in such an arrangement. In India, the industry has generally emphasized the need for giving a greater 'practical' bias to the degree courses. The educators have been vascillating between the need for providing a sounder scientific base and the need for meeting the so called immediate needs of the industry. While it is true that training which has no immediate practical significance is to a large extent wasted, in this age of science and technology, the needs of the future cannot be overlooked. A proper balance has to be struck between the various elements that should constitute the degree courses with an eye on the future.

More than the degree courses, the diploma courses have come in for a lot of criticism. The general complaint is that these courses are pale-shadows of the degree courses. The tasks to be performed by the diploma holder—middle level personnel—are varied and it has been unfortunate that in our country, the diversity that is needed in such courses is woefully lacking. Local needs are important because the mobility of personnel at this level is not so great. Professionals in the various fields could do a great deal by defining the needs in their respective spheres, so that 'technicians' play their part fully and well and provide the right type of assistance to the engineer.

Need for consolidation

There has been almost a craze for establishing new institutions in different parts of the country and particularly so at the degree level. This has led to imbalance in the proportion of graduates and diploma holders, and consequently improper utilization of qualified manpower. The degree holders are being employed on jobs which do not require that level of training. It has also led to the situation where we have small institutions, not so viable for performing efficiently the tasks entrusted to them. Even so, there is a continual demand from the States for more institutions. Let us hope that reason will prevail and everyone will come to recognise the need for consolidation and improvement of quality rather than frittering away our meagre resources and energies on establishment of more institutions.

I have taken much more time than I had intended to and I am grateful to you for bearing with me. I would now request our distinguished Chief-Guest to address the meeting.'

Madhya Pradesh Centre

Chairman's address by Shri V. D. Gupta, M.I.E., at the 8th Annual General Meeting of the Centre on February 1, 1967

After welcoming the Chief Guest, Shri S. N. Gupta, Chairman, Madhya Pradesh Electricity Board, and other invitees, Shri Gupta thanked the Committee of the Centre for electing him Chairman for the ensuing year.

Delivering his Chairman's address, Shri Gupta said:

'I am deeply grateful to you for the honour you have done me in electing me as Chairman of the M.P. Centre of the Institution of Engineers (India). I am aware of the great responsibility that is associated with this post and I hope to do my best by following the trail blazed by my illustrious predecessor, Dr. Dokras, Prof. A. Lakshmanswamy, Shri Koli, Prof. Sarwate and others.

I take this opportunity to welcome our Chief Guest, Shri S. N. Mehta, Chairman, M.P. Electricity Board, and heartily thank him for kindly accepting our invitation to preside over the eighth annual convention. I also welcome all the guests who have graced this occasion by their presence.

The members of the Institution of Engineers (India), M.P. Centre, deserve to be congratulated for the excellent work done in the short span of seven years. This Local Centre has earned a place for itself amongst the various other Local Centres in the country and I am confident that with your co-operation the centre will continue to carry on the good work in much greater measure.

For any activity of this kind, it is most essential for the Centre to have its own premises, and the efforts in this direction are now being crowned with success. Through the good offices and generosity of the Madhya Pradesh State Electricity Board authorities, the Local Centre has been fortunate to obtain approximately half-an-acre of land at a very reasonable cost, in the centrally situated Royal Hotel premises. Only a few days ago, on January 16, 1967, the Chief Minister of M.P., Honourable Pandit D. P. Mishra laid the foundation stone of the proposed building of the M.P. Centre of the Institution.

Let us now apply ourselves to the task of putting up the building. The Local Centre has an ambitious plan of putting up a building and an auditorium which when completed would be the pride of Jabalpur. The task before us is to strive hard to collect donations, contribution in cash or kind, public and private aid, etc. This task needs the co-operation of one and all—members, friends, well wishers and all.

As has been the tradition from years past, I shall now venture to give an exposition on a subject which I have taught for years. My talk will be on the evolution of the I.C. engine, from its pioneer days till the time it became established.

It was the King of England, Edward III, who on one good day in 1327 A.D. thought of the feasibility of converting the power of explosion into mechanical effort. The word 'mechanical work' had not then been coined. The explosion of gunpowder in a primitive cannon was used to produce some work. The experiment was not fruitful and was never completed and repeated, but its occurrence was recorded in Latin by some courtier. The Renaissance came but did little for the cause of the I.C. engine. In 1677 experiments with gunpowder were recommended by C. Huygens of Holland, without any encouraging results. Then came a pause till the early 1800's.

Then came the period of the vaccum-principle engine. Street of England constructed one, with great success in 1794. Air was hand-pumped into the cylinder causing the piston to rise for a part of a stroke. Liquid fuel was then poured in and ignited by the hot end of the cylinder, which was located in a furnace. The explosion and subsequent expansion forced the piston upwards and in the process pumped water. The expanded gases were then cooled to create a partial vaccum, which combined with the effect of gravity, caused the piston to return to the bottom of its stroke.

It was James Watt who invented the principal features of a reciprocating engine, though he advocated steam for making the piston move. Born of middle-class parents and physically very delicate, Watt was a self-educated person. He started as an instrument-maker and when one day asked to repair the primitive Newcommen steam engine he discovered that he could improve it. With no money in hand, after his initial failure, he approached an educated friend for financial help. His friend was too obliging and both Watt and his friend, Dr. Roebuck, were in financial difficulties when the next experiment failed. Dr. Roebuck, with bankruptcy staring in his face, sold his interest to a friendly manufacturer. And in 1780 the first Watt engine was built. Watt writes 'The velocity, violence, magnitude and horrible noise of the engine gave unusual satisfaction to beholders!' People around could not sleep unless the engine seemed furious and breathless, for the noise conveyed great ideas of its power to the ignorant.

With the mechanism of converting the reciprocating motion into rotary motion and the reciprocating engine perfected, only two aspects to establish the I.C. engine remained—the fuel and the cycle.

In the period 1815-20, a young Frenchman of Napoleonic France devised and analysed the Carnot cycle and explained the correlation between work and internal energy. Sadi Carnot otherwise led an unspectacular life and did little else of recognition except coining the motto: 'Speak little of what you know and not at all of what you do not know', which incidentally reveals his own nature.

And soon later John Ericsson, a Swede immigrant to England, brought forth the idea of a cycle with a regenerative effect. With a passion for machinery, he built a locomotive called 'Rocket' to compete with Stephenson's engine. The Rocket ran at an amazing speed of 30 miles per hour and as the London Times described it: ' It seemed to fly; presenting one of the most sublime spectacles of human ingenuity and daring'. He designed the screw propeller for steam ship, which became popular much later. Above all, he designed a hot air engine for a boat, but the engine and the boat were lost in a squall after the first launching. Ericsson subsequently migrated to New York where he spent his last years, strangely enough, in writing articles and giving speeches on the evils of the telephone.

In years to come the cycle captured the interest of the scientist and the problem of determining the proper fuel was ignored. Gunpowder still remained the only source of heating air to produce a mechanical effect. The steam engine reigned supreme and Watt and Stephenson were proclaimed heroes.

However, in 1799, an unknown Frenchman, Phillippe Lebon, had already thought of the possibility of igniting a fuel-gas-air mixture with a spark. But he never could construct a working model because machine tools were scarce or not there at all.

In England, John Barbar had made fuel gas from wood and charcoal in 1791 for a crude gas turbine and Rivaz and Cecil in 1820 tried to replace the steam engine by a gas engine as a road vehicle. William Cecil in 1820 made, what was probably the first working gas engine, the gas used being a mixture of hydrogen and air. And Barnett of England in 1838 expounded the importance of compression and the application of a flame for ignition. Then came a period of stagnation which turned the scientist's mind backward and the I. C. engine sunk back into the days of gunpowder.

Italy partook in this gunpowder plot in the form of two scientists—Barsenti and Matteucie—who built a free piston engine with gunpowder as fuel and engaged a ratchet attached to a shaft on the downstroke. The days of primitivity, it appeared, were coming again. But good sense prevailed and the Italian engine after a few initial sales dropped out of favour.

In 1860, Lenoir of France, built an engine without compression. Though inferior to other engines, which had come out earlier, a notable construction of Lenoir was followed by Hugon who thought that by spraying water into the cylinder the Lenoir engine would improve and tried to put it in practice but his expreiments proved futile.

The most important development from France came from Beau de Rochas in 1862 who defined the 4-stroke cycle and the importance of compression. The cycle again gained importance as de Rochas established a line of efficiency calculations. All of de Rochas achievements were theoretical and hypothetical.

Nicholas August Otto also independently evolved the four-stroke cycle and produced a satisfactory design of a gas engine eliminating roughness and noise. Called the 'silent engine', it was exhibited in the Paris World

Fair in 1874. As credit and honour poured in, Otto started in partnership an engine manufacturing plant in Germany.

In 1873, Brayton of America developed an engine running on constant pressure combustion and complete expansion.

To circumvent Otto's patents and also probably to prove that a Scott is superior to an Englishman in intellect, Sir Dugald Clerk, born in Glasgow, invented and exhibited the two-stroke gas engine in 1881.

The scientist, satisfied in perfecting cycles of operation, now turned his mind to the fuel problem. A spate of discoveries, spurred by Otto's success, followed. The high cost of gas provoked Hock of Vienna in 1873 to experiment with fuel oil injected into a cylinder in the form of a spray, thus emulating a gas. As combustion conditions remained primitive Hock's experiment ended up in failure. Then Brayton of America took up the challenge and evolved a combustor for gas and liquid fuels. In 1882, Spiel of England decided that a light oil would be the most appropriate substitute for gas. Probably the first oil engine should be accredited to Priestam of England who in 1885, sprayed heavy oil into the combustion chamber by compressed air. And Herbert Ackroyd Stuart, again of England, experimented with a carburetted mixture of oil and air and concluded that the introduction of fuel should be delayed till the end of compression.

Fascinated by Otto's discovery and with the primary aim of developing an I. C. engine utilizing coal and operating on self-ignition, Rudolf Diesel of Germany, came upon by accident on the idea of a constant pressure cycle. Assured by the feasibility of his cycle in practice, he, with the financial help of others built an engine in 1892. The engine unfortunately exploded on the first injection of fuel, almost killing Diesel. It was only after four more years of tedious effort that Diesel produced a successful engine. Rudolf Diesel, after giving the world one of its foremost discoveries, lived an embittered life, almost constantly penniless, and was pronounced lost when a ship in which he was travelling disappeared during a storm while crossing the English channel.

In 1884, in a small town called Wurttenberg in Germany, an engineer bearing the name Gottlieb Daimler revolutionized the Otto engine by conceiving the carburettor and the era of variable speed engines and automobiles started. In England and in Germany factories competed with each other to produce multi-cylinder engines for heavy work. Daimler also proposed his plans for balancing the extraneous forces produced by the reciprocating parts. High speeds now captured the engineers imagination. A Daimler contemporary, Karl Benz, invented the high tension ignition system and another German, Wilhelm Mayback, invented the float chamber of the carburettor. In the 1890's Prof. Trinkler of Russia perfected the solid injection system. In almost every minute discoveries poured in, improvements were suggested. Imagination soared to peaks. The I. C. engine was now an entity, with a sound existence.

The first gas turbine was probably the windmill. John Barber invented a regular gas turbine as back as 1791—the turbine using coal gas—but his achievement was never accepted as of value. It remained for Joule and

Brayton to discover cycles for it. The first unit to produce net power was built in 1906.

The first self-propelled vehicle driven by steam was built in France in 1770 by Nicholas-Joseph Gugnot. It was a three-wheeled vehicle. Then the locomobile started appearing in England in the 1830's and filled the people with such consternation and indignation that the British Parliament imposed a heavy tax on them to dissuade further usage.

Lenoir of France drove the first automobile with a gas engine. It was Daimler and Benz who made the I. C. engine light and speedy and built the first gasoline automobile. In America, the Duryea brothers built more of these 'horseless buggies' in 1894. The first automobile manufacturing plant was built in New York by Seldon in 1895.

The first motor-car exhibition, held at Madison Square Gardens in 1900, symbolized the advent of the great American engineering achievement that was to become its greatest national industry. By 1913 most of the two million automobiles in the world were in the United States. From the Gas Buggy of Charles E. Duryea, there had been a rapid kindling of interest. Ransom E. Olds of Michigan had built several steam cars before this. His Oldsmobile manufactured in 1897, encouraged him to set up a factory in Detroit with an annual production of 425 cars. By 1904 there were 121 car manufacturers in the United States, who formed the Association of Licenced Automobile Manufacturers. There was one manufacturer who did not join this Association. His name was Henry Ford. An enthusiastic mechanic, he built his own steam engine at the age of 15 and became the Chief Engineer of the Edison Illuminating Company at the age of 33. In 1896, Ford built his own car running, on four bicycle wheels. After persistent failures and economic difficulties he established his company in 1913, producing a car in about 2 hours. By 1919, his companies were operating in full swing, sending 2 million cars to the market annually.

In 1911, the selfstarter for the automobile was discovered by Bendix and Kettering and the patents were purchased by Ford.

Parallel to Ford were the stories of Crysler, Nash, Hudson, Studebaker and White. In 1908, the Buick Factory was converted into General Motors, which soon absorbed Oldsmobile, Caddilac and nine other companies.

Motor bus services first appeared in 1898. London had 5,000 motor buses by 1904 and by 1914 there were 50,000.

Aircraft engines of the light petrol type were first conceived and made by Charles Mainly and the Wright Brothers in 1903. The challenge then spread to France where the radial engine was improved and modified.

Both German and American experimenters enabled the I. C. engine to take the air. Otto Lilienthal began gliding experiments near Berlin in 1891. His gliders were built of cotton fabric stretched on willow ribs. Both he and his follower P. S. Pilcher of Glasgow were killed before they could provide mechanical power to their gliders. In 1892, Hiram Maxim tried to construct a helicopter running on a steam engine. His copter rose two feet above the track. In 1898, Alberti Dumont, a wealthy Brazilian inventor began to experiment with automobile engines in airships. He advocated that his airship be used for sighting submarines. It was the Wright brothers in 1903 who enabled the I. C. engine to transcend the roads and take to the air. They also solved the principle of simultaneous control of altitude in the three axes of space.

Apart from Ericsson, notable contributors towards marine I. C. engines were Daimler of Germany who, in 1886, attached a two-stroke engine to a launch and Thorneycraft of England who used a gas engine with an attached suction gas plant to drive a small ship. Priestman of England introduced in 1905 the crude oil burning marine engine. And in Germany the Sulzer Brothers modified the Diesel engine for marine purposes in 1905. In 1923 the Sulzer Company produced a 13,000 b.h.p. marine engine.

The first use of rockets cannot be stated with certainty. An old well-illustrated Chinese manuscript describes the fire arrow used by Chinese against the Mongols in 1232 A.D. It seems probable that the Greeks knew about rockets much earlier.

Since its earliest beginnings the rocket has been used both as a wartime weapon and a peacetime signalling device. In First World War it was used infrequently as an offensive weapon. In Second World War, however, it appeared as a major offensive weapon and also showed possibilities of being capable of propelling aircrafts.

The underlying development which have brought the rocket to its present prominence must be credited to the imagination and efforts of Ziolkoveky and Rymin of Russia, Oberth, Valier Opel and Sangen of Germany, Pelterie of France and Dr. Goddard of the United States. These men saw in the rocket its great possibilities of attaining extreme altitude and for space travel.

These early years were days of thrills, of success and failure, when money was scarce and when will alone made the scientist persist. Opportunities were little then and ideas were born from the deep reaches of the human mind. But these indefatigable few set the pace, more in an adventurous spirit than otherwise, and soon the pace hastened to reach fantastic proportions. From the composite unit, interest was diversified to each of the components till part after part achieved perfection. They made the I. C. engine compact, light, high speed, perfectly balanced free from vibrations, cold starting, air cooled, water cooled, streamlined, smokeless, antiknock, noiseless and capable of using various fuels. They juggled with it till it could mow the lawn for you or fly your son's toy plane. Now they are weaning it from reciprocating motion and making it crankless. They have used it as a medium of conquering the ways of the earth, the deep seas and the earth's atmosphere. Now they seek with it the dark regions of the universe.

Though the internal combustion engine, in some form or the other, remains today the supreme means of exploring the deep seas, the remotest corners of the earth's surface, the sky and the moors and the boundless and universe unknown to mankind, it may soon go as it remorselessly displaced the steam engine, only to remain as points of references in outmoded books in libraries. But let the old days be remembered, when achievements were valued and the I. C. engine was born out of the spirit of adventure in men. Let there be one among us who will pen the eventful life of the I. C. engine and who will treasure the memory of these bygone days in his heart. Let him be the historian who will bring back the days when the oil engine chugged and appeared breathless, when the gunpowder exploded, when the wheels squealed when they turned and when the piston was free.

Gentlemen, probably my talk was arduous and heavy. But let us make our presence felt and respected. Let us be regarded not only as creators of tools and machines but as makers of ideas with the will to put them into practice.

Nagpur Centre

Chairman's address by Prof. V. V. Sardesai, B.E. (Mech.), B.E. (Elect.), M.I.E., at the Annual General Meeting of the Centre on January 14, 1967

After welcoming the Chief Guest, Shri Purtej Singh, General Manager, Bhilai Steel Plant, and other invitees, Shri Sardesai thanked the Committee of the Centre for electing him Chairman for the ensuing year.

Delivering his Chairman's address, Shri Sardesai said:

'I wish to express my thanks to Shri Khare for installing me as the Chairman for the ensuing year, and I am grateful to the retiring committee of this Centre for having elected me to that post.

It is indeed a matter of great pleasure that Shri Purtej Singh, General Manager, Bhilai Steel Plant, is with us this evening to inaugurate our Annual Session. Inspite of his pre-occupations and responsibilities, he has been kind enough to respond to our invitation, and we are all very grateful to him for his presence amongst us today.

For more than two decades I have been actively engaged in imparting education to the students of engineering and technology and have felt the changes that have taken place therein from time to time. I, therefore, feel it appropriate that I should speak on problems of engineering educators, being a teacher belonging to that category.

Since achieving independence, the country has made rapid progress in the development of heavy, medium and small scale industries, requiring a constant supply of engineers and technicians, capable of shouldering the manifold responsibilities that confronted them. It was, therefore, natural that to meet this demand, new educational institutions had to be set up and had to grow in size giving an output of engineers sufficient in number and of the required quality.

It is evident that the engineers of today have to perform jobs of a different nature than those they had been doing a quarter of a century ago. As a consequence, the education and training of an engineering student had to be changed so as to enable the engineering graduate to take up the challenge that faced him after passing.

Notable changes during the past 15-20 years have been the changes in duration of courses, from 3 years to 4 years after Intermediate Science or Pre-Professional Examinations, to five years after Higher Secondary School Certificate Examination, and 3 years after B.Sc. examination, changes in the curricula with a strengthening of basic sciences and introduction of new subjects, new laboratory techniques, introduction of metric teaching and changes in the examination systems, all aimed at producing a more competent engineering graduate.

Have we succeeded? Is the employer now satisfied with our products? If not, why so? Most institutions in the country are either running the five-year integrated course after Higher Secondary School Certificate Examination, or are committed to that course. Barring a few institutions which conduct their own admission examination, admissions given are generally on the basis of marks obtained in the Higher Secondary School Certificate Examination. The question now arises: Are the grades of this examination really representive? A survey recently conducted about the subsequent performance of selected students from the merit list for a number of years, has not been very encouraging. Many of these have not been able to keep up, not only their ranks but also their divisions. Some have even had failures! Though this does not warrant a generalization, still it does make one think, that if the admissions are to be made from the Higher Secondary level, a carefully planned test including aptitude test should be given while selecting the candidates. The introduction of the 3-year course after B.Sc. in Civil, Mechanical and Electrical Engineering, is only serving as an opening to students who probably could not get admission at earlier stages and is likely to add to quantity and not to quality as has been envisaged in planning such a course. It might prove useful in some specialized branches only.

In the present time many of the universities are changing their curricula to include more mathematics, more physics, more chemistry, at the expense of workshop, drawing, engineering laboratory, etc. If one were to defend the inclusion of sufficient shop and drawing in engineering courses, one would be called old fashioned and suggestions are invariably made that such 'skill' subjects should be relegated elsewhere. The fact that a graduate in medicine has to take any number of such skills is rarely taken note of. A celebrated personality whose name I would not mention, has said in the course of a lecture that while he was prepared to defend the emphasis on basic sciences, he was troubled to note it was so often at the expense of an experience and understanding that can come only from a laboratory. He further went on to say that much of the time he spent in the foundry, machine shop, drafting room, etc., was time wasted, because in his after life he never was called upon to pour molten metal in a sand mould or worked on a lathe, but in retrospect, he felt the hours spent gave a balance and a perspective to his studies and his entire outlook. It is essential that in some way we find a modern means of accomplishing this same result.

Complete changeover to metric teaching was to have been accomplished by 1965-66. This has not been so, ostensibly, due to want of good text books, established and one university does not compete with the other in giving more marks or less marks. Incidentally, there is a lot of criticism levelled at our universities for having a system of external examiners. I do not see what harm can come out of this? It is good to have an impersonal third party assessment of your product! It also to a certain extent tends to equate standards in different universities. From this point, joint paper setting and examining by an external examiner and the teacher of the subject, has got its own merits and as such this system where it exists, need not be discarded.

Examination papers are one of the surest methods of influencing the teaching of the subject. Examinations are not an end in themselves, but in addition to their purpose of establishing the quality of a candidate, they are to be used as a guide to the training of students of the future.

Another problem which newly started institutions have to face is the lack of proper equipment in the laboratories. All these institutions get a capital grant for purchase of equipment from the Central Government and they have to make these purchases as laid down in a carefully drawn list. Whereas some of the items are available in this country, quite a few have still to be imported. Each institution is called upon to carry on an endless correspondence to obtain various clearances regarding foreign exchange, no objection certificate, import licence and so on, resulting in loss of time and energy, not to mention the increase in prices that results due to these delays. Since, by and large, the equipment purchased by various institutions is alike, will it not be advisable to have a Central agency which can attend to these purchases? Instead of giving grants in amounts of money, the imported equipment could be made available to the institutions. By ordering a large number of pieces of the same type of equipment, by negotiation, prices can be brought down considerably, resulting in an actual saving of the foreign exchange. In any case, it certainly would result in elimination of duplication of work.

At this stage, I must say that Indian manufacturers are not giving sufficient attention to this particular problem. Most concerns are unwilling to depart from the manufacture of their standard products to oblige institutions. Experimental equipment is of a different type and unless the manufacturers realise their responsibilities towards technical education, things will not improve. After all, a well trained engineering graduate will be of great use to the Industry and would save their training time, which they have to spend on him in any case. Even though the above proposition is uneconomical from the point of view of the manufacturer, in the strict sense, ultimately all losses will be compensated.

Most of the industrial concerns in the country have, at one time or other, to take some engineering students for in-plant training. There is no fixed programme in most of the cases, and these students are left to themselves to learn and to benefit. It is essential that much more interest is taken in their training programme by the authorities than is being done now. This is another investment which is bound to bear rich fruit in the long run. The period of 6 weeks or so of such training is most inadequate and the students must be made to spend at least 6 months in the industrial concerns at one time during their education. Lack of time should not be made an excuse, as this can be easily made up if we cancel many of the holidays and reduce vacations. This brings me to another aspect, that of holidays. It is absolutely necessary for keeping up continuity of the teaching programme that there should be no midweek holidays on any account. This means, all our extracurricular activities such as sports, social gathering, debates, etc. should be on week ends only. This has been discussed many times but not followed in totality so far. Five days, forty period working per week, come whatever may, should be our motto. Some institutions are doing this with admirable results. There is no reason why this practice could not be followed by all the rest.

Most valuable engineer from an industralists' standpoint is a person who has had a broad background in designing, which enables him to follow the project from the initial sketch to the finished prototype. A person capable of making a good working layout, supervising the drawing of details, checking up the drawings, following up manufacture of parts through tool shops through assembling and testing is constantly sought to fill positions of responsibility, and we must aim at producing graduates who can be developed into persons of the above capabilities.

Industry cannot expect the colleges to equip the students with sufficient training patterned to the needs of all business, and they must also keep in mind that the engineers in colleges today are being trained for the next many years of usefulness. However, they have a right to expect a good return for the wages they pay. If the industry cooperate, becomes an active participant in the training of engineering students and realises its responsibility towards technical education, I am sure, many of the problems could be solved to the mutual benefit of the employer, the educated, and the educator.'

Rajasthan Centre

Chairman's address by Shri Yadav Mohan, M.I.E., at the 8th Annual General Meeting of the Centre on February 2, 1967

After welcoming the Chief Guest and other invitees, Shri Yadav Mohan thanked the Committee of the Centre for electing him Chairman for the ensuing year.

Delivering his Chairman's address, Shri Yadav Mohan said:

'The Institution of Engineers, Sir, it may be recalled, was first organized in the year 1919 with a small membership of 138. In recognition of its usefulness and character, and the services it had rendered to the country, it was recognized by the Government of India, and a Royal Charter was granted to the Institution in September 1935. Since its inception, the Institution has been making steady progress and today its membership exceeds 14,000 Corporate Members.

For many years, Rajasthan was included in the Central India Centre with its headquarters at Delhi, and for this reason, the members resident in this State could not get the full benefits of the Institution. The establishment of a Local Centre for Rajasthan was approved in 1959. At the time of the formation of the Centre, there were only 89 Corporate Members and 398 Graduate and Students on the rolls. Today the number of Corporate Members is 223, and that of Graduate and Students 2,275, making a total of 2,498.

It will be seen that the Centre has been making steady progress in membership. But there should be no room for complacency on this score. There are about 1,000 members in the State eligible for corporate membership, and continued efforts are necessary for their joining the institution.

Our country had been stagnant in development for centuries. But vast agricultural and industrial programmes have been undertaken since the advent of Independence. There is the over-riding problem of gaining sufficiency in food. It is equally essential to achieve an industrial capacity which will enable us to manufacture industrial plant and machinery required for development. It is of the highest importance that our dependence on other countries should be reduced to the minimum in the shortest possible time. In the modern technological age, it is not natural resources alone that determine the prosperity of a country. It is by technological improvements, hard work and the development of resources that natural wealth and national incomes are built up, wherefrom only the living standards can improve. India having had a late start has to put in even greater effort to catch up with developed countries. In achieving this, professional institutions like ours can play a large part. The learning and experience of an individual may help him in solving his problems, but they will be lost to the community, unless he participates in organized discussions at a professional level. The main advantage accruing from a professional fraternity is that a continuous advance of engineering knowledge and engineering talent of the country as a whole, is facilitated.

I would therefore make an earnest request to all engineers in the State to join the Institution and thereby strengthen the profession and serve the nation even better.

The Centre has so far been working in a hired building. It gives me great pleasure to convey to the members that the construction of the building for the Centre will soon be taken in hand and the Centre will have a regular home of its own, which will provide better facilities to the members. The new building will be located on the Ajmer Road. A plot of 5,203 sq. yd. of land for the building has already been taken for the Institution. The designs have been finalized in consultation with architects, and construction is proposed to be taken up during the year.

To keep abreast of latest developments in technology, it is necessary to keep our minds open, receptive and vigilant about latest developments. At no time in history, the rate of progress has been so rapid as it is in the present times; and indeed the rate of progress is so rapid, that often the latest ideas become out of date by the time they are put into operation. Therefore, to be of greatest service as engineers, we must keep our minds open to accept and adopt new techniques and methods, and keep in touch with latest developments by studying the latest literature. The Local Centre of the Institution should offer further opportunities for all this in its new premises.

It is usual for the person delivering the address to speak on the activity with which he has been closely connected. It would therefore be expected of me to speak to some extent on the Rajasthan Canal, which, as is well known, is the biggest and longest canal so far undertaken in the whole world.

The Rajasthan Canal seeks, in one gigantic effort, to transform a vast wasted stretch of the Great Indian Desert into a prosperous fully developed region humming with agriculture, industry and commerce.

It has been proved that the present aridity of Rajasthan is artificial and of comparatively recent origin. Eminent geologists have estimated that the change from prosperity to barrenness in this region must have occurred during the last 5,000 years or so.

The Ganga Canal in Bikaner has concretely demonstrated that the Rajasthan desert is indeed not a barren tract beyond redemption. It is a land of dormant fecundity. This Canal has transformed a hot, inhospitable stretch into cool orchards now famed for their fruits. Only water was needed to bring the sandy tracts to life.

The search for water to rejuvenate the great desert in a big way and make it smile into lush fields and luxuriant orchards took concrete shape with the dawn of independence. According to the latest agreement with Pakistan, India can use three of the Indus Basin rivers—the Ravi, Beas and Sutlej. The Sutlej waters will be fully utilized by the Bhakra Project. The Rajasthan Canal has, therefore to draw from the Beas and Ravi Rivers. Supplies from April to September can be drawn directly from the Beas. A storage reservoir is, however, essential for perennial running of the Canal. Work is proceeding on the construction of a huge earth dam on the Beas at Pong for creating this reservoir.

The preparation of the Rajasthan Canal Project was taken up by the Central Water and Power Commission in the year 1951. The Commission conducted surveys of the area and in its preliminary project report recommended the construction of the Rajasthan Canal from the Harike headworks which is situated just below the confluence of the Beas and Sutlej. Thereafter detailed surveys were carried out by the Rajasthan Government and a detailed project was prepared. The project was approved by the Planning Commission and sanctioned by the Government of Rajasthan in July 1957.

The project originally sanctioned provided lining of the Rajasthan Feeder only in its first 110 miles through the Punjab territory. This was considered essential to prevent seepage of water and to minimize the chances of water-logging in the Punjab State. At that stage, the Rajasthan Feeder in Rajasthan as well as the Rajasthan Main Canal were proposed to be constructed as unlined earthen channels.

However, in view of the fact that the entire tract, through which the canal passes in Rajasthan is sandy, and the absorption losses would be very heavy and would result in large quantities of useful water being wasted, it was decided to line the Rajasthan feeder and the Rajasthan Main Canal in their entire length, and some branches, etc. later on.

The gross area commanded by this Project is 50 lakh acres, out of which 37 lakh acres are culturable. The area expected to be irrigated annually is

28.75 lakh acres. More land is available near the area being proposed to be commanded by this Canal. But more areas cannot be included in the command, as water which is available to the Rajasthan Canal is not enough for irrigating these additional areas.

The total length of the Rajasthan Canal system will be 4,346 miles, which includes 134 miles of the Rajasthan Feeder and 292 miles of Rajasthan Main Canal. The remaining length of 3,920 miles consists of branches, distributaries and minors. The length of the field channels is expected to be about 40,000.

The Rajasthan Canal Project is proposed to be constructed in two stages. Stage 1 comprises of the Rajasthan feeder, the Rajasthan Main Canal up to mile 122, and branches and distributaries taking off the Main Canal up to this chainage. The Main Canal below mile 122 and all the offtaking channels from this reach of the Main Canal are included in Stage 2. Stage 1 is proposed to be completed by the year 1970-71 and Stage 2 by the year 1978-79. Works of Stage 1 are at present under execution. The 111 miles of the Rajasthan Feeder in Punjab have been completed. In Rajasthan also the remaining 23 miles of the Feeder have been completed. In addition, 48 miles of the Feeder in Punjab have been completed. Main Canal and Distribution System commanding about 9 lakh acres have been completed and work is in progress up to mile 72.

Irrigation commenced in 1964 and about one lakh acres have been irrigated this year. The expenditure incurred so far on the Rajasthan Canal exceeds Rs. 45 crores which is 60% of the estimated cost of the first phase.

The construction of a vast system of the channels on this Project involves an excavation of earthwork to the tune of 11,000 million c. ft. The number of railway wagons required for handling this earth in one operation will, if placed end to end, cover the circumference of the earth five times over. About 7,000 labourers, 5,000 donkeys and 200 earthmoving machines are working in the excavation work.

There is however very little cultivation being done in the area commanded by the Canal at present; nor are there enough people at present residing in these areas. To achieve the benefits of irrigation expected from this project, the areas served by the Canal will have to be colonized with people from outside. For the establishment of colonies in this area, other ancillary works of development like houses for colonists, roads, railways, post and telegraph offices, schools, hospitals, demonstration farms, forest belts, etc. will have to be done. A master plan for the development of the area to include these essential activities is estimated to cost Rs. 213 crores, out of which Rs. 63 crores will be in the Central sector and Rs. 150 crores in the State sector.

The Canal will bring innumerable benefits to the directly commanded areas as well as to the area adjoining it, and will develop a very prosperous economy, with agriculture, industry, commerce, forestry, animal husbandry and fisheries with model layouts of abodes and model housing. In addition, it will bring benefits of much needed drinking water to neighbouring towns and villages, control the spread of the desert to the adjacent lands, and reduce the locust menace. All these add up to a picture of undreamt prosperity for the area.

I would now like to refer to some of the important subjects which need attention at all levels.

One of the most vital fields with which we are actively associated is food production. India has the largest irrigated area in the world. Out of a culturable area of 190 million hectares, an area of 145 million hectares is cropped, and about one-fourth of this is under irrigation. During the fifteen years of planning, we have increased our production of cereals by about 21 million tons. In spite of these impressive additions, we have had consistently to import large amounts of food grains from different sources. This unenviable position has been ascribed to a variety of causes such as vagaries of monsoons, lack of incentives to farmers, want of credit facilities and shortage of fertilizers. It has, however, to be conceded that low productivity has been the most serious deficiency in India's agricultural practices. The per acre yields of most of our crops are a fraction of those obtaining in advanced countries. And for meeting the country's needs, this yield has to be augmented considerably.

For increase of output over the areas already under command, there can be no better measure than the improvement of the agencies in charge of administration, in particular, those of irrigation and agriculture. So far as the farmer is concerned, he wants all the inputs necessary for the successful operation beginning from ploughing to the harvesting of the crop. In between, he needs irrigation as the primary input, because assured water at the right time is the foundation on which, with more fertilizers and improved agricultural methods, he can raise his land to its highest output of yield of foodgrains or cash crops.

The media through which these inputs reach the cultivator are important. It is necessary that these inputs flow to him smoothly rather than the cultivator having to waste his time for securing them by submitting a large number of applications and then chasing his request from door to door in the various offices. Thus it is necessary to build up a closer team spirit in the agencies responsible for achieving results in the field of irrigated agriculture.

Coming closer to our own profession, we have to appreciate that an Engineer's main responsibility is to produce results of the best quality in the minimum time, and at minimum cost. That requires full awareness of the quality, time and cost factors, and an Engineer must have full understanding of these aspects. The Institution of Engineers (India) held a very informative symposium in November 1961 on 'Efficiency of Engineering Enterprises in India'. This was widely attended and views were freely and frankly exchanged. These deliberations highlighted three major objectives, 'Efficiency, Economy and Expedition' and emphasized that anything which militated against any of these three essential objectives must be eliminated.

The first requirement is efficiency and proper construction. It is obvious that in our present state of economic development, we cannot afford slip-shod work, or unnecessary expenses.

The next important aspect is economy. Our resources are limited. Therefore, economy has always to be kept in view. But we must guard against a false economy. For example, cutting down on research or cutting down on essential equipment would be a false economy. But all the time this view of economy has to be kept in mind.

The third requirement is speed. As we know, there has been an explosion of expectations in our country over the last 20 years. Although our countrymen are patient, they cannot be expected to wait indefinitely.

There are certain further aspects regarding ourselves which need introspection. Although engineers are hardworking and persistent people, they generally confine themselves to their work. By and large, they cannot express themselves well and therefore remain in the background. But, the future of India depends on their whole-hearted participation, and it is necessary that they assume a leading role in the shaping and implementing of national policies, particularly, those connected with development. For this it is essential that they open out and speak up. Leadership is never conferred. It is earned. Engineers have to participate in the State and Central Legislatures, the Planning Commission and as Ministers of Government. Then only will a scientific and technological climate prevail in the country, which is necessary for moulding the shape of the future India of peace, plenty and prosperity.

We must also encourage publication of articles by engineers. It is not very material if they are not of a very high standard. Quality improves with time; and it is only if we write that we will eventually produce works of a higher quality. Frequently, the work on which a person is employed does not look important to himself. But it is often new and of great interest to others, working in allied fields. We must therefore publish our experiences in the interest of the profession and the country.

We must also recognize the fact that only a well-informed man can be a well-informed engineer and that this will not come about unless we take deliberate steps to do so.

The senior members of this Institution should seek deliberately and systematically to teach the newcomers what they themselves have learnt in the sphere of engineering practice. This will be real contribution to the formation of the next generation of professional engineers. We should take this as a part of our professional responsibility. The enthusiasm of youth has to be taken maximum advantage of. If our nation- is to become great, it is the youth of India who will make it great.

Politically, the torch of leadership has recently been passed to younger generation of Indians, and technologically also, it is the younger generation that has now to come forward and play its role.

There is one other matter which is not of engineering interest alone. It is really of grave national importance. While our needs warrant bringing into the scientific and engineering vocations, the highest possible talent available in the country, right from the university level, the set-up of our public services today is unfortunately not conducive to meet this requirement. One of the primary reasons is the great disparity between the scales of pay and service and social prestige, as also opportunities of promotion between the technical and non-technical services. Because of such unwholesome and unreasonable disparity, many good students in the universities are tempted to take to non-technical services. A number of them go to the administrative side even against their aptitudes. The country thus loses year after year many potential top-ranking engineers and scientists through a mal-adjustment of the pays and prospects between the different public services in the country. In the interest of the development of the country, it is important that these disparities be removed at the earliest possible time.

While on the subject, it would be relevant to recall that the Government decided to constitute four All India services in 1961-62, viz., those for Engineerring, Medicines, Forests and Education. But the I.S.E. has still not been constituted. It would be interesting to recollect that when the late Sardar Patel constituted the Indian Administrative and Police Services, he did it almost overnight. He called all the Chief Ministers to Delhi and resolved all points across the table. In the case of the integration of the Princely States, the Sardar went round himself or sent round his Secretary to meet the various Princes, and he was able to integrate about 600 States in the course of a year. If therefore, the Prime Minister sends a dynamic technocrat round the States to work out the details with the State Governments, and calls the dissenting Chief Ministers to Delhi in the same exercise as Sardar Patel did, the Indian Service of Engineers can be put into full swing in three or four months. Lest the conditions should grow worse, it is very essential that the Prime Minister takes personal interest in the engineering services which are the backbone of the country's economy.

The bulk of expenditure on our Five-Year Plans represents and will continue to represent expenditure on engineering activities in the fields of agriculture and community development, irrigation and power, industries, transport and communications etc. It is axiomatic therefore that the keymen in these enterprises must be the engineers.

In our country, it is bureaucrats and generalists, who predominate, with the result that both achievement and production efficiency suffer. Technical people are production men and their duties are connected to tasks. On the other hand, a bureaucrat is largely confined to the desk. When this generalist dominates over the technical services, he is unable to understand the real needs and problems; he has initially to educate himself which results in the technicians having to do more paper work largely for him. The field activities inevitably suffer.

The advice again and again for a change in the present system is the outcome of a desire for rendering more effective service rather than gaining precedence in the matter of protocol or prestige. For ensuring better production in fields, which require technical experience and skill, it is essential that leadership be entrusted to Engineers. To my mind, the day is approaching when all concerned will agree to this change, and the technical people will not have to spend so much of their energy unfruitfully.

Finally a word to my brother-engineers: at this juncture in history we stand at a crucial point. A great responsibility devolves on us to ensure the economic and industrial growth of our country as rapidly as possible. So everyone of us should take positive and creative interest in his work. Everyone of us should be proud of his assignment and should live with his work. As Bacon said, 'Every man is a debtor to his profession from which he seeks position and profit, and so ought he to endeavour, by way of amends, to be a help and ornament to his profession' or, in the words of Voltaire, 'Only in fulfilling ourselves at the highest level of our capabilities, and development of our lives in terms of usefulness to the community of man, can we justify ourselves as members of the human society'.

In conclusion, may I say again how honoured I am by having been elected as the Chairman for the ensuing year. If by having placed some of my thoughts before you, I have been able to stimulate some thinking, I shall feel greatly rewarded.

I thank you, Sir, and the distinguished gathering for giving me a patient hearing. I am also indebted to our guests who have kindly responded to our invitations. May I now request you, Sir, to inaugurate this Session of the Rajasthan Centre of the Institution of Engineers?'

Uttar Pradesh Centre

Chairman's address by Shri S. P. Sinha, B.Sc., B.Sc. (Engg.), M.I.E.E., M.I.E., at the 46th Annual General Meeting of the Centre on December 10, 1966

After welcoming the Chief Guest and other invitees, Shri Sinha thanked the Committee of the Centre for electing him Chairman for the ensuing year:

Delivering his Chairman's address, Shri Sinha said:

'It is my privilege and pleasant duty to welcome you to this 46th annual general meeting of the U.P. Centre of the Institution of Engineers. It is our great good fortune that Rawatji, our Minister for P.W.D., is with us this morning to inauguarte this meeting. His regard for engineers and the interest which he has been taking in their affairs are well known. We are deeply grateful to him for the trouble which he has taken to come to our meeting today. Our thanks are due also to our other distinguished guests who have come to grace our function. Their presence is an indication of the fact that we are amongst friends whose good will is a source of encouragement to us.

Since we met at the last annual general meeting, our country has suffered irreparable loss in the passing away of its Prime Minister, Lal Bahadur Shastri, than whom a nobler soul is difficult to imagine. A man of rare qualities and a political leader of the most extraordinary abilities, he has left behind a trail of glory which it would be difficult to match. Alas! he has been taken away at a time when the country needed him the most. On behalf of this Centre and on my own behalf I pay homage to his memory. To Sm. Indira Gandhi who has succeeded to the high office, we send our greetings. Her ideals and policy which she has enunciated from time to time, have produced a sense of confidence that the country's affairs are in safe and competent hands.

My friends of the outgoing Committee have called me to the office of Chairman of the U.P. Centre of the Institution of Engineers for the coming year. They have conferred upon me an honour for which I am deeply grateful to them. Needless to state that I shall spare no efforts to vindicate their confidence in me. I know that in the fulfilment of the task enjoined upon me, I shall need the cooperation and support of all my friends of this Centre, which I am sure will be given to me in ample measure.

On an occasion like this it would not be inappropriate to take our minds back to the early days of the founding of this Institution. You may be aware that this Institution owes its birth and existence to the foresight and constructive genius of a batch of eminent engineers of nearly fifty years ago, who felt keenly that if engineering has to fulfil its role in India, it must have an indigenous institution of its own and not just look for inspiration to overseas bodies. The Institution was inaugurated in 1921 and right from the beginning its membership became a hall mark of quality. In 1935, thanks to the efforts of the late Sir Rajendra Nath Mookerjee, the Institution received the Royal Charter which conferred upon it a recognized status comparable with that enjoyed by engineering institutions in the United Kingdom. It will be appreciated, therefore, that in the matter of status our Institution stands on the level with its counterparts in the U.K. It may be lagging behind in the matter of tradition and membership, but it is comparatively young and there is no reason why the present shortcomings will not be made up with the passage of time. While on this subject, I would ask my friends to remember what is laid down in our Charter, viz., that the object and purpose for which this Institution has been constituted are to promote the general advancement of engineering and engineering science and their application and to facilitate the exchange of information and ideas on those subjects, amongst members and otherwise. In short, the Institution stands for Engineering and Engineering profession in a rather selfless way.

The territory covered by the U.P. Centre has a predominantly rural economy. Nevertheless, there is vast scope for industrial development and consequently vast scope for engineering talents. We engineers ought to keep in close touch with the trend in planning and be prepared to play our part in the industrialization of the State as opportunities arise. We should be ready with uptodate ideas of designs, specifications and methods. Our aim should be to attain that degree of advancement which will put us in a position to export ideas instead of having to borrow them from others. I would commend to my younger friends, particularly Students, the study of electronic engineering which has been found of immense assistance in industrial fields in other countries. I would suggest to engineering colleges and polytechnics to endeavour to develop in their pupils what may be called 'quest mindedness'. An engineer whose mind is so developed will have no difficulty in devising ways and means for himself.

Since Independence, the State of Uttar Pradesh, like other States of the Indian Union, has launched a number of large engineering projects which have placed it well on the road to progress. It is a long road indeed, the conquest of which will require, among other things, the employment of all the energy and talents which the engineering profession is able to provide. Engineers must give their careful thought and attention to the problems of rural electrification because it is the rural economy that will largely determine the national prosperity. So far, electricity is only an urban amenity. Judged by the present rural standards, its price is high. Furthermore, rural projects are far from remunerative. It is difficult to visualize a time, in the near future, when the price of electricity would be low enough to suit the present rural standard. And yet rural electrification must proceed, may be, as a long term investment, subsidised for the present, in the larger interest of the nation.

I do not propose to take your time with the narration of statistics. They are readily available in the Government of India publications. A perusal of these statistics is both gratifying and depressing. They tell us about our achievements but, at the same time, they underline our backwardness among the foremost nations of the world. They point forcefully to the need for further massive effort all round.

The Energy Survey Committee appointed by the Government of India has carried out some very interesting study of the comparative cost of the three modes of generation of electricity available in this country. It has declared that hydro is the cheapest, that thermal (steam) comes next and that atomic is a close third to thermal. The present tendency, however, is that the cost of conventional power is going up and that of atomic power is coming down. When the rising and the falling curves meet, that would be the dawn of atomic era on which so many hopes are built. Future advancement in atomic technology coupled with the need for conserving coal for other essential industrial uses and the remoteness of the residual hydro sources from load centres, may usher this era sooner than we know. It may interest you to know that the reserves of atomic fuel of the country are estimated to be more than 15 times the known reserves of coal.

Engineering nowadays is a rapidly advancing science. In the olden days one could hope to keep abreast of technological advancements by a study of technical journals. The present day advances are so complex that this method does not serve the purpose any more. The need for refresher courses has never been greater than at present. The authorities that are organising refresher courses are rendering a most useful service to the cause of engineering. The only thing that I may be permitted to point out is that in planning these courses due care may be taken that they fit in with the actual needs of industries and or institutions, and that they do not make a call upon engineers' time greater than they can conveniently take off from their normal vocations.

When our President Shri B. P. Kapadia, visited this Centre a few months ago, he laid great stress on assistance to Students in their preparation for Institution examinations. We in this Centre were fully alive to this need and a start was made a few years ago in this direction by way of coaching classes which we sponsored. These classes were popular and very useful. Later this programme in our activities had to be given up as it was considered inappropriate for us to be a party to teaching arrangements. Be that as it may, the way has been clearly shown. Therefore it should not be difficult for others to fill the role which we have had to abandon. I have a feeling that our Students are somewhat handicapped in the matter of laboratory training which to my mind is essential to an engineer's make up. It should be our endeavour to make the training of our Students as complete and broadbased as possible. Therefore, something will have to be done to remove the present handicap. I propose to ask the incoming Committee to apply its mind to this problem.

An engineer's role is one of designing, planning, organising and executing the project placed in his charge. Finance and control are usually placed in other hands. This set up, though basically sound, fails sometime to work smoothly. There is a tendency on the part of the second party to assume the role of senior partner for which it is not qualified. The resulting friction vitiates the climate required to produce a bumper engineering harvest, if I may use the expression. Engineers are judged by the results which they are able to show, therefore, they owe it to themselves to raise their voice of protest against what they feel is a handicap on their performance.

In order that engineering efforts produce the maximum results it is necessary to create an atmosphere which will stimulate thought and encourage enterprise, beget confidence and promote investment, eliminate obstructive tendencies and generally foster a spirit of comradeship. It is only in such an atmosphere that constructive forces of the required magnitude can be generated. Let the authorities give serious thought to the matter. I am confident that given the proper setting, engineers can produce the most gratifying results.

Now let us turn our attention to ourselves. This Centre is now in the 46th year of its existence. It has two Sub-Centres, one at Roorkee and the other at Allahabad. A third Sub-Centre is in the offing and a fourth may follow. The latest figures of membership are 166 Members, 779 Associate Members, 149 Graduates and 5,253 Students. The figures for Corporate Members are somewhat disappointing. A concerted membership drive is called for. The Centre is housed in a building of its own but the present building falls short of its needs. A plan for the extension of the building has been drawn up but construction works has had to be deferred on account of insufficient funds. The economic stress of the present time makes it impossible for members to come forward with generous donations to the building fund. I must acknowledge with thanks the substantial assistance which this Centre has received from the State Government towards the construction of the present building. I have no doubt that our appeal for further aid will not go in vain. I must appeal also to the industrialists of this state to come forward with a helping hand. Our library at Lucknow has over 3,400 books on its register and a further 500 books are on order. We have provided not only books of reference but also a fairly large number of text books for the use of our Students. The parent Institution provides funds for the library every year and we make substantial and useful additions. The Institution has donated Rs. 4,000 for 'Book Banks' established at Roorkee and at Allahabad. Every year in November and May A.M.I.E. Examinations are held at Lucknow, Roorkee and Agra. In the last Examination at Lucknow, 980 students appeared. The number of examinees has been going up steadily, so more examination centres may be needed. Our examination arrangements at Lucknow are made in *Shamianas* as well as in the main building. When our building extension is completed it may be possible to do away with *Shamianas*.

We have what we call a 'Student Chapter'. Under this programme we provide funds and guidance to engineering schools and polytechnics to organise students' activities, technical and otherwise, that are likely to stimulate students' interest in engineering technology generally. Students are encouraged to write papers on technical subjects and are awarded prizes at a function specially arranged for them.

It gives me great pleasure now to invite my friends of the Institution of Engineers (India); U.P. Centre, into the new year. Let us hope that the new year will see all round progress and that our efforts in advancing the cause of engineering and in contributing towards the welfare of society will meet with success.'

Summaries of Papers Published in the Journal vol. 47, no. 11, pts. CI 6, ME 6, and MM 3, July 1967

CIVIL ENGINEERING DIVISION

624.5.001

1. Simplified Treatment for Analysis of Suspension Structures—Part 1. H. Barua, *Member.*

This paper presents an analysis of cables used in various suspension structures in a simplified manner. The author has solved numerical examples on two-hinged and hingless suspension bridges by this method. It also outlines the analysis of self-anchored suspension bridges and long-span cantilever bridges suspended by ties.

624.131.53.001

2. An Assessment of Earth Pressure Theories. F. Basu, *Associate Member.*

The literature on lateral earth pressures recognizes a coefficient of static earth pressure but there is no certainty about its value In this paper the static coefficient obtained from theory and variations of earth pressure observed by all known workers have been explained. The coefficient has practical applications in unyielding structures.

532.001

3. Non-Dimensional Parameters in Fluid Mechanics. P. R. Bhave, *Associate Member.*

Non-dimensional parameters such as Froude number, Reynolds number and Mach number have wide engineering applications and, therefore, they are well known. However, in fluid mechanics there are various other

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phenomena, though not very common, where recourse to other non-dimensional parameters is necessary. An attempt is made in this paper to describe such non-dimensional parameters.

627.89.001

4. Failure of the Khadakwasla and Panshet Dams. Prof. N. S. Govinda Rao, *Member.*

This paper records the results of the author's findings on the failure of Khadakwasla and Panshet dams. It also gives details about the dams and briefly describes the construction schedule and the observations made after the failure.

624.159.3 : 624.165

5. On Limiting Scour. Prof. N. S. Govinda Rao, *Member,* **and K. V N. Sarma,** *Non-member.*

An attempt is made in this paper to express limiting scour depths caused by two-dimensional submerged vertical and horizontal jets and scour depths around bridge piers and spur dykes in one form. The importance of Froude number is emphasized. A method is suggested for predicting scour depth in the case of prototype from model studies. The authors have suggested a modification of the formulae presented earlier by themselves

624.023 6

6. Ultimate Strength of Two Hinged Tied R. C. Arches. B. Jena, *Non-member.*

When an arch is loaded beyond elastic limit, the portion under maximum bending moment gradually shows plastic deformation and hence formation of plastic hinges. A two-hinge arch is an indeterminate structure of first degree. Hence for complete collapse it requires minimum two hinges to be formed. Because of inequality of maximum bending moments before the formation of second hinge, the first hinge undergoes certain rotation. Due to this plastic rotation there is change in horizontal thrust which causes change in bending moment diagram. This change in bending moment diagram results in a change of the collapse load. To predict this collapse load, the rotation of the hinges has been taken into account in this paper.

626 : 12

7. A Method of Determining the Most Economical Full Supply Depth in Large Lined Canals (Rajasthan Canal). A. S. Kapoor, *Associate Member.*

In designing unlined channels, the range of variation in full supply depth is limited on account of permissible maximum velocity. However, in case of lined channels like the Rajasthan Canal, a wide range of full supply depth can be considered for designing the most economical section. In this paper, the effect on cost of canal, due to changes in the full supply depth, under different conditions of cuttings and fillings has been examined and presented in the form of curves. The procedure adopted and the conclusions arrived at can be of use to the survey-engineers in aligning the canal and to the design-engineer in fixing the canal dimensions on the Rajasthan Canal and other lined channels.

621.221.4,001

8. **Logarithmic Curves for Surge Tank Problems. G. Krishnaswamy,** *Associate Member.*

The paper presents a quick method of determining the surge heights by the use of logarithmic curves. This method is applicable to elementary types of surge tanks. The types of surge tanks considered in this paper include: simple surge shaft, surge tank with expansion chambers, throttled surge tanks and throttle surge tanks with expansion chambers.

624.072.2 : 624.014.24 : 624.043

9. **Stress Distribution Due to a Rivet Forced into Position in a Deep Rectangular Beam Bent Under Shear. C. B. Mishra,** *Graduate.*

The problem of stress distribution due to a rivet forced into position in a deep rectangular beam subjected to shear has been investigated in this paper. First of all, the stresses due to a rivet made of a different material than that of the beam have been determined. Then the stress distribution in the particular cases such as: (i) when the rivet is of the same material as the beam, and (ii) when there is a circular hole in a deep beam bent under shear, have been deduced. The optical characteristics of such a rivet have also been studied.

626.82.001

10. **Self-Formed Channels in Coarse Non-Cohesive Materials. A. G. Mirajgaoker,** *Associate Member* **and A. K. Jain,** *Non-member.*

This paper presents a study of self-formed channels in non-cohesive material which was conducted in a laboratory tilting flume 40 ft. long, 2 ft. wide and with an effective central section of 20 ft. Four different bed materials having d_{50} as 3.3, 2.5, 1.35 and 0.98 mm. were employed. A constant discharge was introduced to an initially laid V-shape channel with sides sloping towards the centre line of the flume at 10 degrees. This discharge scoured its own stable straight channel in due course of time which varied from 12 to 24 hr., depending upon the size of the material and slope of the channel bed. Based on thirty observations and the data collected by other investigators in this field, the physical factors such as shape, wetted perimeter, cross-sectional area and velocity of flow have been related with the discharge Q, which was a controlled parameter for different bed materials. The results of area of cross-sections were compared with the Stebbing's theoretical analysis and close conformity was achieved. An attempt has also been made to correlate the roughness coefficients with surface samples at the end of the experiments. The effect of initial standard deviation from Manning's value of n and critical tractive stress was also studied. The results are comparable with the studies by earlier workers.

627.826/.828.001.57

11. Model Studies on Arch Dams with Special Reference to the Proposed Idikki Dam. B. Pant, *Member,* **I. K. Nihalani,** *Graduate,* **and S. K. Choudhary,** *Student.*

The construction of arch dams will achieve increasing importance in our country due to considerable economy. However, the successful design of arch dams requires a deeper understanding of the characteristics of the abutment rock and the structural behaviour of the complete three-dimensional structure. For study of this latter factor, model studies assume a vital role. In this paper the authors have given the results of model studies (extending over a year) on arch dams. The type of model studies used for the analysis of arch dams are enumerated and discussion is restricted to the three-dimensional models within working load conditions which correspond with the design analysis normally undertaken. The details of the similitude requirement, selection of material, the construction of the model and loading arrangement and methods of observation and analysis have been included. Certain original techniques such as the use of moisture cells which greatly increase the reliability of test results have also been described. The model refers to a proposed preliminary design of a 550 ft. high double-curvature arch dam across the Perriyar River at Idikki in Kerala State. The model results have been compared with those obtained from a trial load analysis. The points of similarity and differences have been critically examined.

624/628.002.5 : 621.873.2

12. Modern Construction Equipment—Some Recent Trends. M. Verma, *Associate Member.*

Mechanized construction is invariably employed on large projects throughout the world. The equipment used for such construction has undergone a great deal of change during the past few years, and the trend at present is for larger, easier and operationally economical equipment. These trends in fields of earthmoving, drilling, pile driving, hoisting, hauling and highway equipment are discussed in this paper.

RAILWAY ENGINEERING GROUP

13. Waltair Marshalling Yard. M. S. Chakravarty, *Non-member.*

The South Eastern Railway embarked on the construction of a major marshalling yard at Waltair in the later half of the year 1963 to cater for the increase in the traffic during the Fourth Five-Year Plan and to serve the extending Vishakhapatnam Port (Andhra Pradesh). The mechanized hump yard (costing Rs. 6 crores) is expected to be completed by the end of 1966, to deal with over 2,000 wagons a day. The paper describes briefly the salient features of the yard.

624.2 : 625.1 : 624.154

14. Replacing Tilted C.I. Piles of Railway Bridge No. 42 Under Traffic. K.V. Rao, *Associate Member.*

This paper describes a method adopted for replacing the tilted C.I. piles of the existing piers of a double-line railway bridge without dislocating the traffic and within the short time available before the onset of monsoon. The method adopted comprises construction of new R.C.C. piers on bored piles by the side of the tilted piled piers and re-arrangement of the existing girder spans, after which the tilted C.I. piles of the existing piers were cut out. Some of the new R.C.C. piers were constructed, providing a coffer dam around the work spot. The method adopted enables re-building of the damaged bridge without affecting the highly tilted piles of the existing piers.

ROADS AND ROAD TRANSPORTATION GROUP

625.71

15. The Mancunian Way. A. H. Stroud, *Non-member*.

The Mancunian Way lies within the Manchester's planned Inner Ring Road, south of the centre, and is designed so that initially, and in conjunction with the northern area of the Inner Ring, traffic will be drawn to these routes rather than to the central areas of the city. This new route will act as distributor between the heavily trafficked radial roads, south of the city centre. This paper describes the elevated structure, highway standards, loading, bearing friction and restraint, concrete used, site conditions, foundations, columns, bearings, erection, superstucture, deflections, precast segments, joints, stressing, articulation, end blocks, anchorages and abutments, Downing Street bridge, subways, surfacing, drainage, ligting, model study, etc.

MECHANICAL ENGINEERING DIVISION

621—71

1. Heat Transfer During Nucleate Boiling in Vertical Tubes. S. B. Lal Garg, *Non-member*, and Rajendra Prakash *Non-member*.

Most of the existing correlations for nucleate boiling were obtained by using fluids such as water. Experimental studies on the boiling of refrigerants in vertical tubes are presented in this paper. The purpose is to verify if the same correlations can be used with or without modification in the case of Freon-12, working as refrigerants. Detailed analysis for the experimental results have also been given. It is observed that heat transfer during boiling is affected by the presence of oil in the refrigerant and depends on the bubble diameter also.

621.892 : 621.822.5

2. Idealized Plane-Slider Bearing Using Elastico-Viscous Lubricant. T. Ghosh, *Member*.

This paper presents a theoretical investigation to study performance of an idealized slider bearing with an elastico-viscous lubricant. The elasticity of the lubricant is characterized by a non-dimensional number, R_c. The effects of elasticity of lubricant on the pressure, load carrying capacity, frictional resistance and the coefficient of friction have been studied in detail and the results represented by several graphs.

621.752.001

3. Force Transmissibility Provided by Inclined Resilient Isolators in Systems with Two Planes of Symmetry. K. N. Gupta, *Non-member*.

This paper illustrates the advantages of inclined isolators over straight isolators in regard to vibration isolation. Expressions for force transmissibility provided by inclined isolators, in systems with two planes of symmetry, are derived. Experimental values of load-deflection characteristic in compression and shear have been used in determining transmissibility curves for varous inclinations of the isolators. Experimental values of displacement at the isolator for various inclinations are compared with those calculated on the basis of static characteristics. From a discussion of the results, it is concluded that depending upon the load-deflection characteristics, in compression and in shear, there exists an optimum inclination of the isolator providing maximum isolation. Further, the role played by dynamic characteristics in evaluating the performance of the isolator is indicated.

621.9

4. A Probabilistic Approach in Designing High-Speed Machine Tools—a Case Study. P. K. Gupta, *Non-member*, and S. K. Basu, *Associate Member*

In this paper, the need for designing machine tools with wider speed ranges has been pointed out. In order to determine the speed requirements in a particular industry, a method based on the statistical probability of using different speeds is fully described and illustrated with the help of a case study. A quantitative measurement of the gain in productivity obtained by using higher speeds is shown. Using the Ray Diagram and the Compound Ray Diagram, some methods to obtain a kinematic structure for a higher and wider speed range are explained.

621 43

5. Centrifugal Filters for I.C. Engines B. Kanaka Raju, *Non-member* and G. V. Ramanaiah, *Non-member*.

Self propelling centrifugal filters are adopted in many countries for installation on I.C. engines for filtering lubricating oil. This paper aims at describing such filters in general and giving some types of possible arrangements of installation. The authors' experience in the development of a centrifugal by-pass filter at the Central Mechanical Engineering Research Institute, Durgapur, is also given.

621.952

6. Dynamic Stability of Radial Drilling Machine. K. G. Krishna, *Non-member*, and S. C. Das, *Member*.

Advancements in tool materials have made it possible to adopt higher speeds in machining process. But vibration of machine tool structures at high speed often creates a problem. Hence, the dynamic stability tests to determine chatter-free behaviour of machine tools, are gaining in importance In this paper, dynamic stability of radial drilling machine, as analysed by

Gurney-and-Tobias' Method, is verified by practical cutting tests to study the dynamic performance of radial drilling machines manufactured in India.

620.17 : 512.8

7. A Matrix Method of Determining the Stress Distribution in a Rotating Disc of Variable Thickness. N. L. Narasimha Rao, *Non-member,* **and Dr. P. V. Ratnam,** *Non-member.*

This paper presents a systematization of the Donath's method of determining the stress distribution in a rotating disc of variable thickness, with the help of matrices. Also, the superposition principle, utilised in solving the problem of rotating disc in the above method, is substantiated by mathematical analysis

621.454 : 536.7.004

8. Thermodynamic Advantages of Charge Stratification in Spark Ignition Engines. N. N. Narayana Rao, *Non-member,* **Dr. B. S. Murthy,** *Associate Member,* **J. S. Arwikar,** *Non-member,* **and C. P. Gupta,** *Non-member.*

This paper presents a thermodynamic analysis of combustion of lean mixtures obtained by charge stratification in spark-ignition engines and a critical evaluation of the advantages of lower flame temperature resulting from the lean mixtures which reduce the mean specific heat of the gases, chemical dissociation and heat losses to metal walls. Besides this, the advantages of more complete combustion and elimination of throttling or pumping losses contribute a sizeable gain in the part-load efficiency and a saving of nearly one-third in the fuel consumption of gasoline engines. An illustration showing the method of investigation of performance from the combustion charts is also given

621.43

9. Evaporative Cooling for Single Cylinder Stationary Engines. G. V. Ramanaiah, *Non-member,* **M. P. Sankaran,** *Non-member,* **A. K. Maitra,** *Non-member,* **and V. J. Chetty,** *Non-member.*

Evaporative cooling for I.C. engines is one of the simplest, most efficient and compact systems of cooling. The evaporative cooling system, described in this paper for a single-cylinder Diesel engine is virtually free from most mechanical troubles. Improvement in specific fuel consumption to the extent of 3% at full load and 10-15% at part-load and reduction of frictional losses results in improved mechanical efficiency. Substantial saving in copper, to the extent of 48%, is also achieved.

621.454

10. Whither Wankel Engine? G. V. Ramanaiah, *Non-member*

In this paper, the well established reciprocating piston engine and the potential Wankel engine are compared, keeping in view their relative flexibilities and functional efficiencies. A brief account of the development of the rotary combustion engine is also given.

620.176.001

11. The Shear Stress on the Shear Plane. G. S. Sekhon, *Non-member.*

In this paper, a brief review of the contributions leading to better understanding and more accurate calculation of shear stress on shear plane is given. An intercept method of obtaining correct values of the cutting force components is outlined. The origin of the main correction factors is discussed, and some implications of the study are enunciated.

621.892

12. Effect of Additives in Lubricants on Friction and Wear Between Metal Pairs. D. V. Singh, *Non-member* **and J. K. Goyal,** *Non-member.*

Experiments were carried out to investigate the concept that a lubricant having an additive in suitable proportions results in less wear and friction than would be otherwise present under the same operating conditions with lubricant without additive. These experiments included the investigation of the effect of varying quantities of additives in lubricating oils on the wear and friction characteristics. Cylindrical specimen of brass and iron were run on flat mild steel and brass specimen surfaces at a relative velocity of 250 ft. per min. under loads of 8, 12 and 17 lb. Two lubricants, SAE 30 and EP 90, were used along with two additives, lead soap and chromium soap, in different proportions. The amount of metal wear and coefficient of friction were found to depend greatly on the proportion of the additives.

621.454.001

13. Analytical Approach to Combustion Control. T. N. Subramanian, *Non-member.*

In this paper, simplified methods are indicated to obtain fuel economy in the boiler house with the help of nomograms and graphs. Derivations of the basic equations are included and sample calculations added to bring out the simplicity of the approach.

MINING AND METALLURGY DIVISION

1. Coal. R. S. Mishra, *Associate Member.*

This paper deals with coal and its various classification and properties, with special reference to the Indian coal in relation to its metallurgical use.

669.3 (083.9)

2. Project Report on Installation of Copper Plant at Chitradurga. B. G. Rudrappa, *Non-member.*

This report deals with the possibilities of installing a plant to extract copper from the ores discovered near Chitradurga and produce sulphuric acid as a by-product. The proposed capacity of the plant is 3 tons of electrolytic copper and 50 tons of sulphuric acid per day yielding an annual gross revenue of about 1.35 crores. The investment required for this plant would be only 1.95 crores and the net return after deducting maintenance expenses would be 37.5%. A special study made with regard to the possibilities of getting necessary plant and machinery has revealed that most equipment can be obtained or fabricated indigenously and very little foreign exchange would be required to commission the plant.

622.61 : 622.8

3. Safety Aspects of Underground Haulages. Prof. R. D. Singh, *Associate Member.*

Haulage accidents rank third in causing death to underground workers. The pattern of these accidents has remained almost unchanged during the last decade or so. This paper briefly analyses the causes of accidents in four main systems of underground transport, viz., rope haulage, belt and chain conveyors and locomotives. It also suggests the possible safety devices which may be adopted to minimise such accidents.

622.28

4. Application of Rock Bolting. R. K. Singhal, *Non-member.*

Control of the rocky strata comprises problems confronting the mining engineers. Rockbolts are used to support rocks in mines, tunnels, or excavations of all types. This paper discusses in detail the various methods and procedure of drilling and rock bolting, and their relative advantages, disadvantages, etc.

INSTITUTION NOTICES

Application forms for the Associate Membership Examinations to be held in November, 1967

It has been decided that application forms for the Institution examinations will not be printed in the Institution *Bulletin*, any more. Candidates desiring to appear in the Institution examinations will hereafter have to ask for their respective forms either from the Secretary at the Headquarters or the Honorary Secretary of their Local Centre or Sub-Centre, in the requisition slip attached, which may be detached from this *Bulletin*, for this purpose.

Candidates are specifically instructed that while asking for forms, the requisition slip must be attached to a self-addressed, unstamped envelope of the size 9″ × 4″. Candidates should also specifically mention the particular form they desire to have, i.e., Section A or Section B.

The address of the Headquarters is No. 8, Gokhale Road, Calcutta 20, and those of the Local Centres and Sub-Centres are as printed on the inside back cover of the *Bulletin*.

Applications complete in all respects and accompanied by the examination fee for admission to the November 1967 examinations and two copies of passport size photographs pasted in the spaces provided on the application form should reach the Head Office **before 4.00 p.m. on Friday, September, 15, 1967**

Despatch of Results of Examinations

Students are informed that results of examinations will be sent only to their addresses as registered by them in the Institution Head Office at Calcutta.

Scrutiny of answer-books

It has been decided by the Council that from the May 1967 examinations onward, answer-books of all the candidates pertaining to all the subjects appeared by them in any examination will be scrutinized

Candidates need not therefore, apply for re-checking and re-totalling of marks, since these will be automatically done by the Scrutinizers.

Transferring of Exemptions obtained in the Old Scheme of Examination (since discontinued) to the Existing Scheme of Examinations

Candidates who have secured exemptions in subjects of the Old Scheme of examination held upto and including the November 1965 examinations, and desire to appear in the November 1967 examinations, may fill in the appropriate name of the subject(s) in the exemption column after consulting the list published in the December 1965 issue of the *Bulletin*.

Report on the education and training of technicians

A conference of experts from twenty-four Commonwealth countries and British territories, and from international organizations was held at Huddersfield, England, during 1966. The aim of the conference was to help each participating country to secure the maximum possible improvement in its arrangements for the education and training of technicians. To achieve this aim, the conference considered not only a variety of different education and training arrangements, courses and qualifications but also a number of common problems such as the provision, finance and control of institutions, the training of technical teachers, the selection and testing of students, and basic requirements for technicians in terms of the total trained manpower of a country. In addition, the conference considered in detail the requirements for a number of specific types of technicians : engineering, agricultural, business and commercial, etc., and the types of technician education and training of special relevance to women ; particular attention was also paid to the patterns of aid most likely to assist the developing countries.

Three basic criteria for ensuring proper technician education and training emerge from the Report. Firstly, the need for the technician to be adaptable and be person with a broad outlook. Secondly, the supreme importance of associating industry and commerce—the employers—with the planning and implementation of the education and training programmes :

Thirdly, the establishment of an understanding and appreciation of the Status of the technician both with industry and commerce and with society.

Copies of the report could be had from the Commonwealth Secretary-General, Marlborough House, Pall Mall, London S W. 1, and Her Majesty's Stationery Office, London.

Distribution of the *Journal* and the *Bulletin* to members of the Institution

It is being notified for the information of all members that the free distribution copies of *Journal* and *Bulletin* will be sent to all categories of members from the month of July 1967 onwards only in accordance with the stipulations of Resolution 57 of the 449th Council Meeting held in Srinagar on May 27, 1967, which is quoted below:

> 'Resolved that the supply of *Journal* and the *Bulletin* to members, who are in arrears of subscription according to Regulation 56 and if such arrears are not paid by the last day of February following, be stopped as provided in that Regulation.'

For convenience, Regulation 56 is quoted hereunder:

> "Any member in any class whose subscription for the current year shall not have been paid before the first day of November shall be 'in arrears of subscription'. If such arrears are not paid by the last day of February following, he shall not be entitled thereafter to receive publications of the Institution as described in Regulation 65, or upon making such payment at a future date to receive the back publications for the period between the last day of February and the date of his making payment."

Draft Indian Standards

The following draft Indian Standards have been issued recently.

1. Draft Indian Standards Specification for Worm Drive Hose Clips for General Purposes—Doc: EDC 27 (1257)

This standard covers the requirements for work drive hose clips of two types, for general purposes and does not relate to worm drive hose clips for aircraft use.

Members may send their comments on this draft standard before August 16, 1967, to Dr. S. P. Luthra (*M.*), Senior Professor and Head of Applied Mechanics Department, Indian Institute of Technology, Hauz Khas, New Delhi 16, who is the Institution representative on the sectional committee dealing with this standard.

2. Draft Indian Standard Code of Practice for Design and Construction of Septic Tanks: Part 1—Small Installations—Doc: BDC 24 (1223)

This code lays down recommendations for the design, layout, construction and maintenance of septic tanks and includes methods of treament and disposal of tank effluent.

3. Draft Amendment No. 1 to Code of Practice for Structural Safety of Buildings: Loading Standards (I.S.: 875-1964) (Revised)

Members may send their comments on this Code before September 7, 1967, to Shri D. P. Nayar (*M.*), 394/1 Block G, New Alipore, Calcutta 33, who is the Institution representative on the Sectional Committee dealing with this Code.

Members may send their comments on this draft code before August 28, 1967, to Shri N. V. Modak (*M.*), Consulting Public Health Engineer, Udyam, Shivaji Park, Bombay 28, who is the Institution representative on the Sectional Committee dealing with this standard.

Copies of the draft Standards may be obtained from the office of Indian Standards Institution, 'Manak Bhavan', 9 Bahadur Shah Zafar Marg, New Delhi 1, or from its branch offices at Bombay Mutual Terrace, Sandhurst Bridge, Bombay 7; 5 Chowringhee Approach, Calcutta 13; 14/69 Civil Lines, Kanpur, or 54 General Patters Road, Madras 2.

INSTITUTION NEWS

The President visits Madras Centre

Maj.-Gen. S. P. Vohra, President, visited the Madras Centre of the Institution on April 24, 1967. He addressed a meeting of the Members and Students of the Centre on that day at 5.30 p.m. About 220 members attended the meeting. The Committee Members of the Madras Centre met the President at a dinner at 8 p.m. the same day at Connemara Hotel, Madras.

Symposium on 'Relative Importance of Major and Minor Projects in Development of Irrigation', U. P. Centre, Lucknow, August 1967

A symposium on 'relative importance of major and minor projects in Development of Irrigation' will be held towards the second half of August 1967, at the Uttar Pradesh Centre of the Institution at River Bank Colony, Lucknow. A brief note on the symposium is given below. 'Sometimes quite strong opinions are expressed by persons in authority about advisability of stress on major and minor projects in development of irrigation in the country. The stress has even been changing with the individuals charged with development and planning. Controversy seems to be misfounded and harnessing of all major and minor resources may be necessary for optimum development of irrigation potential and even priorities of the two categories of projects may have to be mixed. It may, therefore, be worthwhile that a symposium on the subject may be held. It will provide an opportunity for discussion of merits and demerits of different ideas and crystallize clearer thinking on such an important matter.'

Interested persons may send papers on the above topic to the Honorary Secretary, U. P. Centre, River Bank Colony, Lucknow, before July 15, 1967.

Symposium on 'Construction Costs', Delhi, August 3-5, 1967

As announced on p. 43 of the *Bulletin* for May 1967, the Symposium on 'Construction Costs' will be held at Vigyan Bhavan, New Delhi, from August 3-5, 1967. The Symposium will be held in four sessions as follows:

1. Effect on construction costs due to advance planning, phasing and continuity of workload
2. Cost reduction through rational architectural planning and structural design
3. Cost reduction through research, standardization, mechanization and use of new and improved building materials
4. (i) Cost reduction through management control, organization and integration of different stages of construction
   (ii) Cost reduction by motivation, training and publicity

Further details can be obtained from the Director, National Buildings Organization, Nirman Bhavan, Maulana Azad Road, New Delhi 11.

Proceedings of the Third Annual Session of Student Chapter of Andhra Pradesh Centre, April 30, 1967

The Third Annual Session of Student Chapter of Andhra Pradesh Centre was held in Hyderabad on April 30, 1967. In the business session, Shri M. Moinul Hasan, Honorary Secretary of the Chapter, presented his report on the activities of the Student Chapter for 1965-66 and submitted a statement of accounts and it was approved by the General Body.

Shri O. P. Thimmaiah *(M.)*, Chairman, Andhra Pradesh Centre, inaugurated the meeting. Shri A. G. K. Moorthy, retiring Chairman of the Student Chapter, gave a welcome address. Shri P. G. K. Moorthy was elected Chairman of the Chapter for the ensuing year. Shri B. Sreenivas Rao, Joint Honorary Secretary, presented a vote of thanks to the retiring Chairman and Committee Members. Shri J. V. Narasinga Rao, Minster for Communications, Government of Andhra Pradesh, was the Chief Guest. Shri Dildar Husain, Honorary Life Member of the Institution, also graced the session.

Dr. J. Purushottam (*M.*) presided over the technical sessions. Shri H. S. Subba Rao *(Graduate)* gave a talk on 'Use of Under-reamed Pile Foundations in Black Cotton Soil', and Shri M. K. Naidu *(Student)* gave a talk on 'Priming of Hood Siphons'. Film shows were exhibited by the courtesy of the American Cultural Centre, Hyderabad.

Shilpa Wangmaya Sangraha (Indigenous Technical Literature Museum), Nagpur

A list of books acceded to the Indigenous Technical Literature Museum at Nagpur is given on p. 61 of the March 1967 issue of the *Bulletin*. The following books have now been included in the Museum.

135. The Iron Age of India. N. R. Banerjee. *Munshiram Manoharlal*, Delhi 1965, Rs. 35.00. 264 pages.

136. History of Indian and Eastern Architecture: Vol. 1. James Fergusson. *Munshiram Manoharlal*, Delhi, 1967, Rs. 100.00 for both volumes, 450 pages.

137. History of Indian and Eastern Architecture: Vol. 2. James Fergusson. *Munshiram Manoharlal*, Delhi, 1967, Rs. 100.00 for both volumes, 521 pages.

138. On Yuan Chwanc's Travels in India (A.D. 629-645). Thomas Watters. *Munshiram Manoharlal*, Delhi, 1961, Rs. 40.00, 401 + 357 pages.

139. The Tamils Eighteen Hundred Years Ago. V. Kanakasabhai. *The South India Saiva Sidhanta Society (Tinnevelly) Ltd.*, Madras. Reprinted in 1966, Rs. 10, 260 pages.

140. *Veda Rahasya*—The Secret of the Vedas. Published by T. A. Bambawale, 94/19 Eranduana, Poona, 1962, 173 pages.

Manufacture of Electrical Controls in India

Cutler-Hammer India Ltd., set up in Ballabgarh, with Indo-American collaboration, will start producing electrical controls by the end of 1967. The products will include power distribution and control equipment used in residential, commercial and industrial houses such as, heavy duty contactors, panel mounting eutectic alloy, thermal overload relays, oil-tight push button stations and limit switches, various types of magnetic and manual starters, motor control centres and thermostats for air-conditioning and refrigeration industry. At a later date, the company proposes to manufacture D.C. motor controls, magnetic brakes and many other products developed by the Cutler-Hammer, Inc., U.S.A.

'The Electro-Agricultural Centre', Kenilworth, England

The new permanent Electro-Agricultural Centre, Kenilworth, Warwickshire, England, will be opened on July 4, 1967. It will concentrate on the uses of electricity in agriculture. It will include a permanent exhibition of modern electro-agricultural equipment. This Centre will be administered by the Electrical Development Advisory Division of the Electricity Council, London, S.W.1. The visitors from abroad will always be welcome at the Centre. The intending visitors may contact Overseas Activities Engineer, Overseas Activities Section, The Electricity Council, 30 Millbank, London, S.W.1.

FORTHCOMING EVENTS

Symposium on 'Bulk Handling of Raw Materials', Ranchi, January 1968

The Committee on Research and Development of the Coal Development Council, in collaboration with the Institution of Engineers (India), the Institute of Fuel (Indian Section), the Institute of Indian Foundrymen, Institute of Metals, Coke-oven Managers Association, etc., has proposed a joint symposium on 'Bulk Handling of Raw Materials' to be held in January 1968. The scope of the symposium may be broadly classified under the following heads:

(i) Loading and unloading of coal, ores, liquid fuels

(ii) Transportation techniques (from source and in plant)

(iii) Storage of different capacities

(iv) Design of bunkers for different quality and size of raw materials

(v) Reclamation from stock yards

(vi) Blending systems for coal and ore

(vii) Pipeline transportation of solids.

Interested persons may contribute technical papers under any one or more of the heads listed and any suggestion for addition to the scope are also invited. A short abstract of each paper in about 200 words may kindly be made available by July 15, 1967. The full paper is requested before August 15, 1967. All correspondence should be addressed to Debu Roy, Superintendent, C.E. and D.B., Hindustan Steel Limited, Ranchi-2.

Joint Engineering Management Conference, San Francisco, October 9-10, 1967

The 15th Joint Engineering Management Conference, hosted by The American Society of Mechanical Engineers, will be held in San Francisco, U.S.A., from October 9-10, 1967. The Conference will survey the current critical shortage in engineering manpower and will seek ways to cope with it. The Conference will be held in from sessions on the following topics.

Engineering Manpower Planning

The Acquisition of Engineers—Art or Science

Using People Effectively

Promoting Turnover and Mobility

Further details can be obtained from Mr. Bernard B. Winer, General Conference Chairman, Westinghouse Electric Corporation, East Pittsburgh, Pa. 15112; or Mr. Walter A. Stanbury, Publicity Chairman, Chief Editor, Product Engineering, McGraw-Hill Publications, 330 West 42nd Street, New York 10036.

International Engineering and Marine Exhibition and the International Welding Exhibition, London, 1967

The Siemens Organization is exhibiting a wide range of electrical equipment representing its activities in the power engineering and marine fields. Siemens' capability in the field of power electronics is highlighted by displays of thyristors and silicon rectifiers. Electrical engineering in shipbuilding is represented by a constant-voltage synchronous alternator and three-phase A.C. cargo winches. It has been displayed how the Siemens Organization has played an important part in the building-up of the worldwide telex service. On show is a Siemens Teleprinter 100, a page printer operating on the stop-start principle, which meets all applicable international engineering conventions. The range of exhibits is complemented by large photographs and transparencies illustrating the wide-ranging activities of the Siemens Organization.

BOOK ACKNOWLEDGMENTS

1. **Fundamentals of Applied Mechanics.** V. D. Dadhe, M. G. Jamdar, and Y. N. Walavalkar. *Deshmukh Prakashan*, Poona, Rs. 15, 1966, 598 pages.

The book is meant for students of polytechnics. The chapter on 'Revision' will help the students to recollect their earlier lessons. The subject matter is dealt lucidly. The 'Mathematical Tables' given at the end of the book will be of help to the readers.

2. **Workshop Processes and Materials—Vol. 1.** J. Schofield. *Blackie and Son Ltd.*, 17s 6d. 1966, 212 pages.

This book stresses the safety and safe practices in workshop processes. Metric system has been used throughout the book. Metric measuring instruments, serial-taps, degrees, Celsius and British metric conversions have been included. The B.S. and I.S.O. recommended symbols, abbreviations and procedures have been followed, whenever possible.

3. **Understanding Graphs.** S. A. Knight. *Blackie and Son Ltd.*, 18s. 1966, 321 pages.

This book explains how relationships between numbers can be shown pictorially by graphs and charts and gives examples of practical applications. In the survey of elementary general mathematics, a formal approach has been avoided and the practical need of technicians and engineering students taken care of. Conversion graphs from British to metric units are discussed.

4. **Elementary Design of Steel Structures.** G. P. Nagarkar. *Deshmukh Prakashan*, Poona, Rs. 10, 1966, 188 pages.

This revised sixth edition of a book followed the revision of I.S.: 800 and I.S.: 875. A chapter on 'Composite Beams' is an addition. Figures and graphs drawn to a bigger scale and a few examples for practice have also been included.

5. **The Indian Electricity Rules, 1956.** N. Bharucha. *The Bombay Presidency Association*, Bombay, Rs. 40, 1966, 635 pages.

This book provides a practical approach to the study of the Indian Electricity Rules. An analysis of the rules has been set out in considerable detail, together with case-laws on the subject, citing the decisions of Indian Courts of Law and of the Supreme Court of the U.S.A. The book will be of interest to the licentiates in electrical engineering, licensed contractors, electricians, wiremen, and all those connected with power generation and transmission. Extracts from the U.K. Electricity (Factories Act) Special Regulations 1908 and 1944, and from the Electricity Orders, 1956, under the U.K. Mines and Quarries Act, 1954, have also been quoted.

6. **Elements of Thermodynamics.** D. ter Haar and H. Wergeland. *Addison-Wesley Publishing Co., Inc.*, $7.00, 1966, 160 pages.

This book details the topics of thermodynamics such as stability, mixtures, chemical equilibrium, the third law, and systems in external fields. Proceeding deductively from phenomenological axioms, the book lays the basis for a study of statistical mechanics. Solved problems are given together with examples based on industrial applications.

7. **Introduction to Fluid Mechanics.** R. W. Henke *Addison-Wesley Publishing Co., Inc.*, $6.50, 1966, 232 pages.

The text is designed to meet the needs of manufacturing and process industries and places emphasis on fluid mechanics related to fluid power. It does contain enough of fundamental fluid mechanics to fulfil the requirements of the individuals who may later work with fluid machinery or in the process industries. The material in the text will be useful to polytechnic and engineering college students.

8. **Practical Mechanical Design.** J. G. Tweeddale. *Iliffe Books Ltd.*, 7s. 6d. 1966, 183 pages.

This book covers in a condensed form most of the problems encountered in elementary design fundamentals applied to all branches of engineering. It gives the engineers' approach to such topics as the estimation of working loads and of load conditions, the analysis and resolution of load stresses, the determination of the relationship between the mechanical properties of materials and working load conditions and the evaluation and use of safety factors.

9. **Worked Examples in Direct Current for Engineering Students.** P. J Freeman. *Asia Publishing House*, Rs. 7.50, 1966, 138 pages.

This volume enunciates the basic principles of direct current circuits and machines in worked examples. The examples given in each section are graded, and it is necessary for the students to try part 1 at first.

10. **Stoichiometry.** L. K. Nash. *Addison-Wesley Publishing Co., Inc.*, $3.10, 1966, 182 pages.

This book explicitly cites the fundamentals of stoichiometry. The topic is divided into the following five chapters: Atomic-molecular theory; Kinetic molecular theory; Systematic assignment of atomic weights; Systematic assignment of molecular formulae; and Confirmations, extensions and qualifications.

11. **Elements of Organic Chemistry.** A. H. Corwin and M. M. Bursey. *Addison-Wesley Publishing Co., Inc.*, $9.50, 1966, 746 pages.

The plan of organization of the book has been according to ideas rather than according to classification of substances. The authors have endeavoured in this book, to present the student with research situations beginning with the simplest and progressing to the more complex, so that he may understand the intellectual basis of the discipline and may secure initial practice in scientific methods.

12. **Engineers: The Anatomy of a Profession.** J. E. Gerstl and S. P. Hutton. *Tavistock Publications*, 43s. 1966, 228 pages.

This book gives, based upon a survey of mechanical engineers in Britain conducted in 1962, engineers' position in modern society with attention to the structure and dynamics of the profession. A wide perspective has been adopted in the analysis, since engineering training must be designed based on national manpower needs. Material on social origin, schooling, professional training, and degree of commitment points to the strength and weaknesses of the present system. The recommendations put forward in the light of the findings of this study will be significant for social science, education, management administration, and for the planning of the expansion of Britain's resources in technical manpower.

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here

Shri M. L. Narasimiengar

Shri M. L. Narasimiengar, M.I.E., died on May 30, 1967, in Bangalore.

Born in Mysore, in 1892, Shri Narasimiengar obtained his B.E. Degree in Mechanical Engineering from the Bombay University in 1918. He was then appointed in the Mysore P.W.D. as a Sub-Assistant Engineer in 1918 and was confirmed as Assistant Engineer in 1922. He was in charge of the Bangalore Water Supply until December 1930. From 1932-36 he worked as Assistant Sanitary Engineer, New Bangalore Water Works. He was then posted to the Bureau of Sanitary Engineering as an Assistant Engineer in charge of water supply installation in the Mysore State. He executed a number of original works both when in charge of Bangalore Water Supply and also in the Bureau of Sanitary Engineering. He was then appointed as the Secretary of the Mysore Paper Mills where the organization and construction of the Paper Mills were carried out under his charge. He became General Manager of The Mysore Paper Mills during 1939-40. In 1946, Shri Narasimiengar was appointed as Director of Industries and Commerce, Government of Orissa, from which post he retired in 1953. He was Chairman of the Mysore Centre for three years, 1945-46, 1955-56 and 1956-57.

A Special General Meeting of the Mysore Centre of the Institution was held in Bangalore on June 8, 1967, which placed on record the deep sense of sorrow at the demise of Shri M. L. Narasimiengar and the valuable service rendered by him.

Shri Narasimiengar joined the Institution as Associate Member in 1933, and was transferred to Member in 1941.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column, a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P.O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

WORKS MANAGER of a public limited industry outside Calcutta, B.E. (Mechanical), A.M.I.E. (India), age 33, with present responsibility over factory and also commercial sides, sale, etc., with brilliant professional achievement, about eight years' thorough experience in machineshop/tool room, production control, administration in the position of Senior Executive in an international British firm and works manager of medium manufacturing industry and an industrial training abroad; seeks change to similar position in a progressive industry in/around Calcutta. Interested to take complete charge of the works and commercial sides or works of a medium/heavy industry as Works/General Manager. Also may change to the position of a Senior/Chief Executive/Departmental Manager of a British/European industry. Emoluments around Rs. 2,000.00 per month, transport, perquisites. (Office ref. E.S. 287).

MECHANICAL ENGINEER, B.Sc., A.M.I.E. (India), aged 32, trained in an ordnance factory and in Germany, 9 years experience in India and the U.K. in design work, tool room, maintenance, production planning and control (including import of raw materials); seeks immediate change for a challenging job. (Office ref. E.S. 291).

AN EXPERT THERMAL ENGINEER, having high qualifications of B.Sc., B.E., A.M.I.E. (India) and with about 16 years experience in modern large capacity thermal power stations in public sector as well as in private reputed undertakings such as TISCO, and with a credit of running the stations independently with success, also experienced in the erection of thermal stations, presently employed in a foreign concern with headquarters in Delhi dealing with turn-key jobs of thermal power stations, intends seeking change in any reputed public or private concern. (Office ref. E.S. 297).

A change with good prospects is sought by an Electrical and Mechanical Engineer who is now holding a responsible position and got 12 years experience in different industries in erection and maintenance work; passed Section A and exempted Section B partially of the Associate Membership Examinations of the Institution of Engineers (India). (Office ref. E.S. 298).

RETIRED ELECTRICAL ENGINEER, B.Sc. (Engg.) (Elec. and Mech.), M.I.E., in very good health, specialist in design, testing, maintenance of electrical machinery and equipment desires suitable employment as full time engineer or part-time Consultant. (Office ref. E.S. 299).

STUDENTS, passed Intermediate Science examination, and Diploma in Civil Engineering in First Division from University of Roorkee, with two years experience in a State P.W.D. constructing bridges and buildings, and in earthwork, and estimating; desires immediate change in a private or Government concern. (Office ref. E.S. 300)

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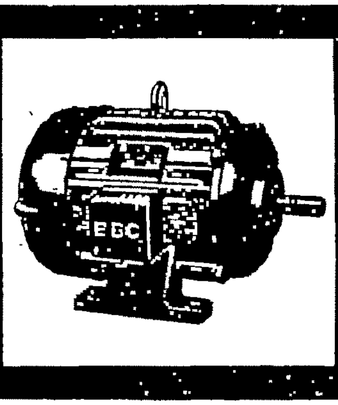

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K Subba Rao :	Co-ordinate Geometry	... 4.00
Shanti Narayan :	Differential Calculus	.. 6.00
" "	Analytical Solid Geometry	.. 5.00
N. Chowdhury .	Basic Calculus and Its Applications	. 2.00

Mathematics II

Shanti Narayan :	Integral Calculus	. 5.00
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Clements and Wilson .	Analytical & Applied Mechanics	10 00
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B. L. Theraja :	Text-book of Electrical Technology (MKSA)	25.00
	Part I and Part II each	13.50
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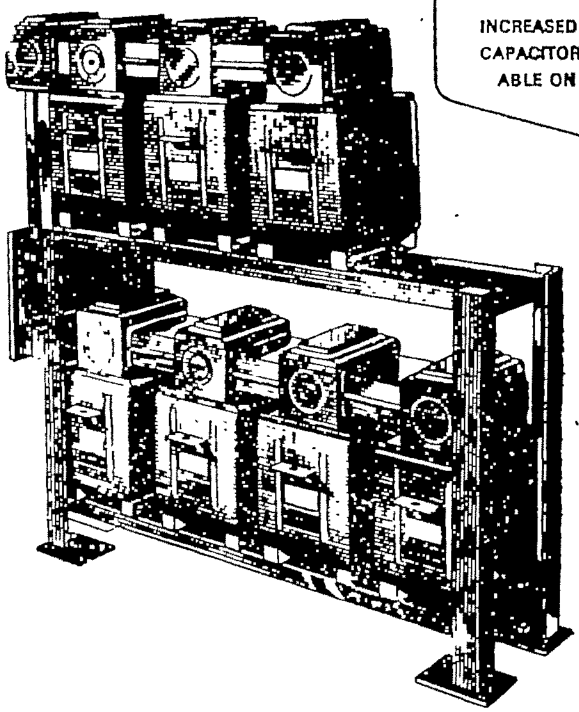

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Punjab	Sector 19A, Chandigarh (*Telephone 418*).
Rajasthan	C-46 Sarojini Marg, C Scheme, Jaipur (*Telephone 73327*).
Uttar Pradesh	River Bank Colony, Lucknow (*Telephone 25322*).

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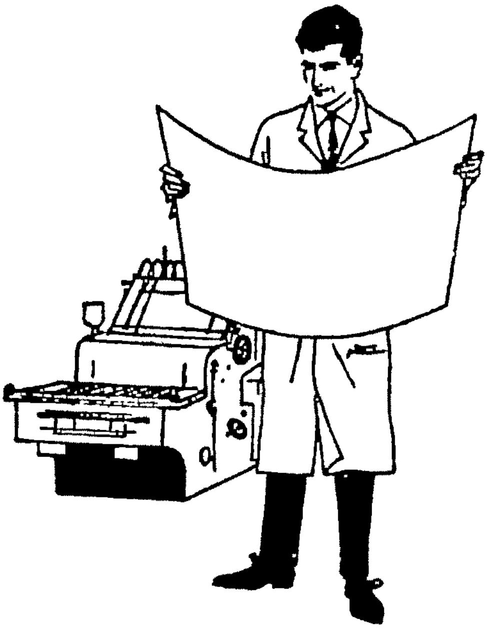

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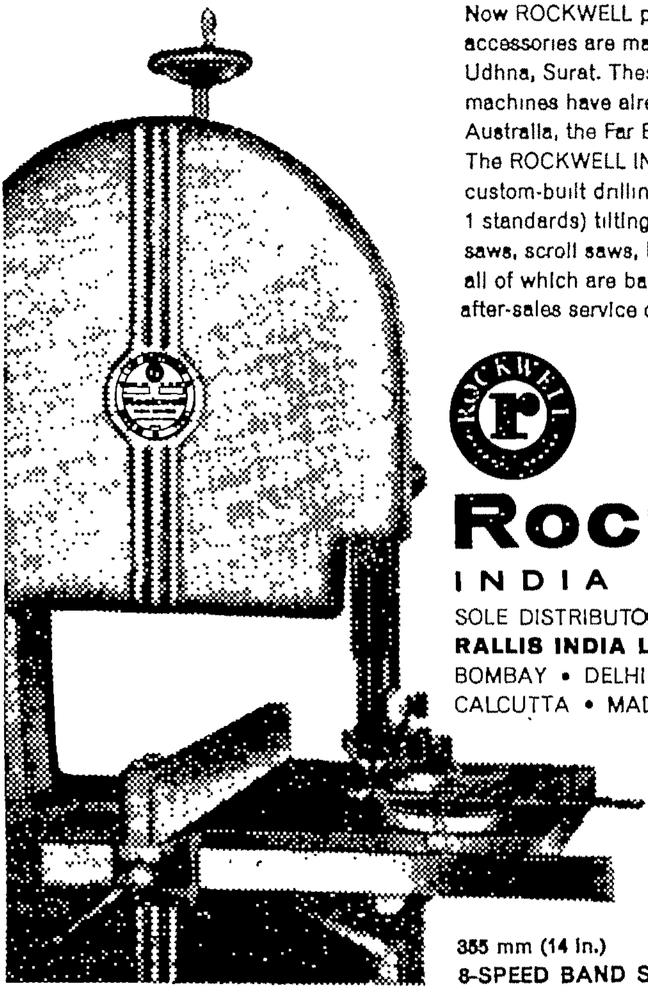

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OF

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Seminar on 'Engineering Industries and Their Development', Ahmedabad, 1968

It is proposed to hold a Seminar on 'Engineering Industries and Their Development' during the 48th Annual Session of the Institution of Engineers (India) to be held at Ahmedabad in February 1968. This would help in expressing the views of the Institution of Engineers (India) by inviting papers from the various members in the profession and discussing them at the Seminar forum. The main points arrived at from the discussion of the papers at the Seminar and the various papers as well as their summaries can then form the basis of preparing the draft of recommendations to the Government of India for their consideration regarding Development of Engineering Industries in the next Five-Year Plan and in future.

In draft outline of the Fourth Five-Year Plan, the Government of India's Planning Commission makes the following observations:

'ENGINEERING INDUSTRIES AND THEIR DEVELOPMENT'

The broad objective of industrial development during the Fourth Plan is on the one hand, to provide for an adequate expansion in the supply of consumer goods, primarily those which cater to the needs of mass of the people, and on the other, to expand the basic and heavy industries supplying the capital goods and intermediate goods at a rapid pace so as to achieve the goal of self-reliance as early as possible. Furthermore, the industrial programme should provide, in accordance with the high priority attached to agriculture, the expansion of capacity in industries which provide industrial inputs to agriculture.

The efforts towards achieving a measure of self-reliance in basic industrial items and capital goods have to be supplemented by a parallel progress towards developing indigenous design, engineering skills and know-how. Some progress has been achieved by developing a number of design and consultancy organizations both in the public and private sectors....'

'.....The industrial programme reflects the broad objectives and priorities of the Fourth Plan. In accordance with the emphasis laid on agricultural production, the goal of self-reliance and adequate supplies of essential consumer goods, the following industries have been accorded priority:

(a) *Industrial inputs for agriculture:* These include fertilizers, pesticides, farm equipment and other material inputs.

(b) *Metals and machine building industries:* These include steel, aluminium, zinc, machinery and machine building industries of all types.

(c) *Intermediate goods:* Including industrial chemicals, petroleum, coal, iron and steel castings and forgings, refractories and cement.

(d) Industries which produce essential consumer goods such as sugar, cloth and kerosene.....'

For this Symposium the broad outline of the heads under which the discussions in Seminars will be held is given below.

I. *Planning and Co-ordination of Industries*

1. Raw materials
2. Location of industries

3. Production and Quality Control
4. Transport
5. Market—(a) Internal, and (b) Export
6. Management

II. *Industrial Research and Development*

1. Development of new materials
2. Improvement in design
3. Improvement in production methods
4. Use of indigenous material
5. Design and Consultancy
6. Maximum use of available talent in the country

III. *Economic Problems*

1. Finance and Capital
2. Import restrictions and taxation
3. Saving of foreign exchange
4. Price control

IV. *Large and Medium Scale Industries*

1. Electrical power industries
2. Machine tools industry
3. Fertilizers and chemical industries
4. Agricultural industries
5. Steel industries
6. Electronic industries
7. Textile industries
8. Mining and metallurgy
9. Industries for defence
10. Other industries

Authors are requested to write papers for the Symposium on 'Engineering Industries and Their Development' pertaining to four major Sections and Sub-Sections indicated above. They are also requested to indicate the Sections and Sub-Sections under which their papers would be classified.

It is requested that the size of the paper should be limited to 10 typed sheets with the double spacing or 3,000 words. A paper should also contain a short summary in about 200 words. The paper should be sent in duplicate addressed to the Secretary, Institution of Engineers (India), 8, Gokhale Road, Calcutta 20, marking on the envelop 'Seminar on Engineering Industries and Their Development' for the Annual Session 1968. The authors are also requested to send one type-copy of their papers directly to the Co-ordinator, Professor M. V. Deshpande, Principal, College of Engineering, Amravati, Maharashtra State.

The paper should reach the Secretary, Institution of Engineers (India) and the Co-ordinator on or before November 15, 1967, to enable him to scrutinize the papers and the Institution of Engineers (India) headquarters to get the pre-prints ready before the Annual Session 1968.

RICHES FROM A SLAG TIP

L. T. C. Rolt

Non-member

The industrial revolution of the 19th century produced waste upon a colossal scale which altered the landscape of Britain's industrial areas. One of the worst offenders was the iron and steel industry. Today, applied scientific knowledge is converting into new riches these substances which were squandered on the slag heap.

For many years tips of blast furnace slag have been quarried for building and road making materials, but now the British Iron and Steel Research Association (BISRA) has developed a process by which an entirely new constructional material of high quality can be produced from slag. The RA calls this Slagceram.

Blast furnace slag consists of lime, alumina and magnesia. By adding extra sand to bring the silica content up to 45-65%, a crude form of glass called 'Vitroslag' can be produced by the normal processes of glass-making, that is to say, by melting, forming and annealing. Like any other form of glass, 'Vitroslag' is amorphous, but if it can be given a uniform crystalline structure it becomes an altogether superior material.

This has been achieved by adding to the melt an agent which will promote crystallization. Oxides of elements such as vanadium, chromium, titanium and iron, as well as some fluorides and phosphates, are all effective at the job.

The production method is still the same as for glass, except that a carefully controlled heat treatment process takes the place of the usual annealing of the formed material. Fine or coarse grained material can be produced. The exact crystal size required will depend on what the material is to be used for, but, broadly speaking, the smaller and more uniform the crystals, the stronger it is.

The product of this process has been named Slagceram. It has high crushing strength and abrasion resistance. It is much harder to scratch than good ceramic tiles. It is more elastic and heat resistant than glass, has a very high electrical resistance and it does not discolour in the atmosphere. Neither will mould grow on it. An experimental panel of Slagceram tiles laid on a busy corridor of the BISRA building in Battersea has shown no noticeable wear, chipping after several months.

Slagceram may be polished, like granite, it may be cut by a diamond-edged saw. It can be mounted in conventional cements as well as in more expensive epoxy resins. Vitreous enamel can be applied before heat treatment, so that the enamel firing is done at the same time, which saves money. It is formed, like glass, by casting or pressing in sand or metal moulds and the method used will determine the surface texture The BISRA scientists have also been looking at the possibilities of rolling Slagceram and adding different bulk colours to the mix.

If the mix is allowed to settle in the furnace before forming takes place, it makes a dense product. But material taken directly from a rotating furnace contains bubbles, so lightweight Slagceram can be produced too.

Most blast furnace slags in either the solid or the liquid state may be used in making Slagceram although it is obviously preferable to save fuel during the melting operation by using the heat already present in molten slag.

SALE OF OLD QUESTION PAPERS

It has been decided by the Council that the reprinting and selling of the past question papers of the Institution examinations will be made by the Institution departmentally.

Messrs. Naba Mudran Private Ltd., who were appointed the Sole Selling Agent for reprinting and selling of the past question papers, will no more be entitled to sell the papers of the Institution examinations. Therefore, all enquiries regarding sale of question papers may be made direct to the Headquarters office at 8 Gokhale Road, Calcutta 20, and not to Messrs. Naba Mudran Private Ltd.

This superseedes the notice given in the July 1967 issue of the *Bulletin*.

SCHOOL OF RESEARCH AND TRAINING IN EARTHQUAKE ENGINEERING, UNIVERSITY OF ROORKEE *

Introduction

The School was sanctioned by the Council of Scientific and Industrial Research as a grant-in-aid unit towards the close of the Second Five-Year Plan in 1960 and has steadily grown during the Third Plan period. Bulk of the northern India comprising of Assam, Bengal, Bihar, North Uttar Pradesh, Punjab, Delhi, Himachal Pradesh, Jammu and Kashmir and Gujarat, is highly susceptible to severe earthquake shocks and the importance of the work at the School is increasingly realized in all these States.

The work of the School has been organized in four research groups: (i) Structural Dynamics and Vibration Mechanics, (ii) Soil Dynamics and Foundation Engineering, (iii) Seismology and Seismo-Tectonics, and (iv) Instrumentation and Observation Studies.

The Structural Dynamics Group works on problems of dynamic characteristics of engineering structures and methods of strengthening them against earthquake and blast forces. Buildings, bridges, water towers, arches and shells are the structures under study (Figs. 1 and 2).

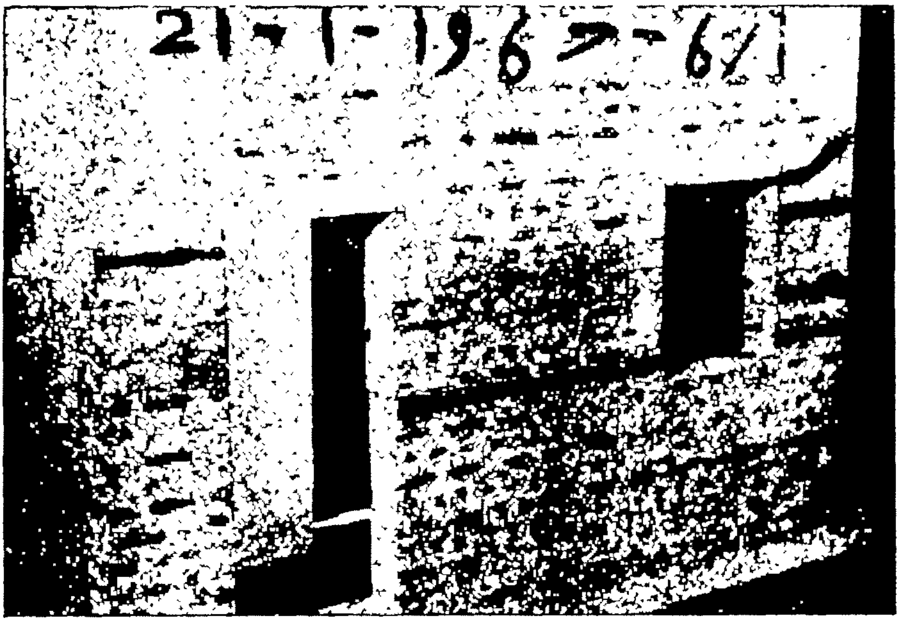

Fig. 1

Load bearing shear wall after lateral load test showing crack pattern

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* Contributed by the School of Research and Training in Earthquake Engineering, University of Roorkee.

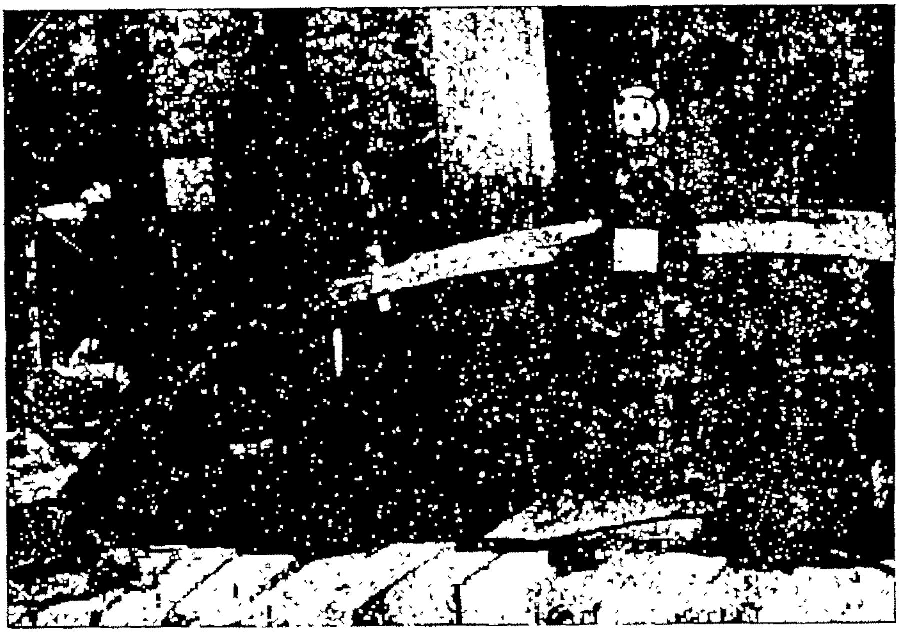

Fig. 2

A concrete arch under test to determine its dynamic characteristics

The Soil Dynamics Group deals with the study of characteristics of soils subjected to vibratory forces and tackles problems concerning the design of earth dams, embankments, machine foundations and other foundations in seismic zones. Facilities are available for investigating sites for their dynamic characteristics (Fig. 3).

The Seismology Group is studying the problems connected with earthquake occurrence, propagation and attenuation of waves and relationship between the size of an earthquake and the energy released. The study of tectonic features in order to understand the mechanics of earthquake occurrence and to delineate the areas into various active zones has been taken in hand. This would help in demarcating the areas where earthquakes are expected to occur in future so that appropriate provisions in the design and construction practices may be adopted.

The Instrumentation Group has designed several instruments required for vibration studies, strain measurements and earthquake observations (Fig. 4).

The research conducted at the School has helped in the better understanding of the earthquake engineering problems and in taking adequate safeguards in the design and construction of engineering projects.

Assistance to industries, defence, irrigation and power

Since the area affected by earthquakes is also undergoing rapid industrialization there is heavy demand from the industries, state and private organizations on the School for advice in the design and construction of engineering structures taking earthquake effects into account. There has also been a continuous demand on the School from the Defence departments and other organizations like Central Water and Power Commission, Irrigation Design Directorates of Punjab, Uttar Pradesh, Bihar, etc., for similar advice. In tendering advice on these projects, basic as well as applied research has been activated and is in hand. Defence and many other departments have made use of the results of research carried out at the School.

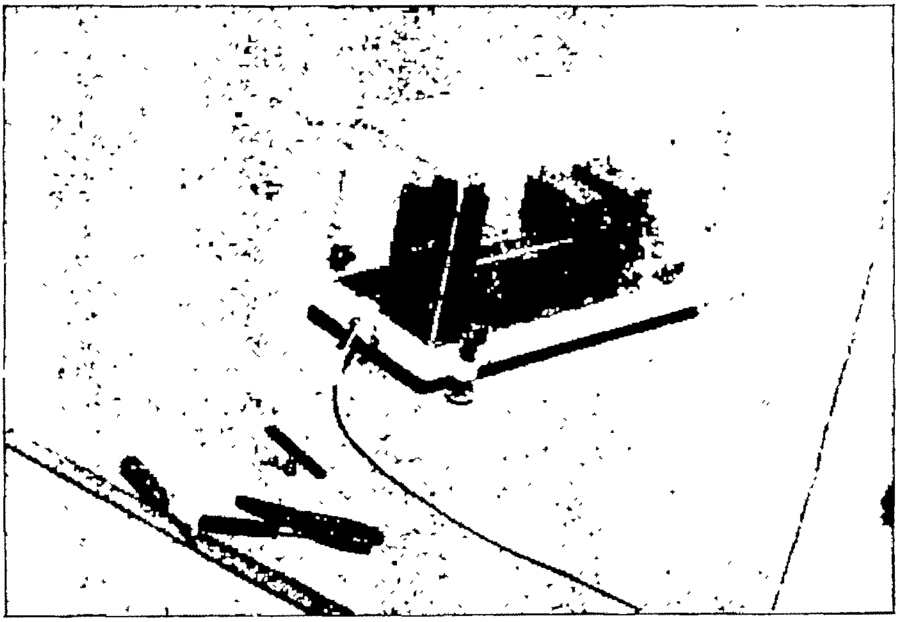

Fig. 3

Velocity pick-up designed and manufactured at the School to study dynamic behaviour of structures

Import substitution

During this period the School has taken up a research and development programme in instrumentation and has succeeded in developing and manufacturing vibration pick-ups of different kinds, shock and sinusoidal vibration tables, modified soil testing apparatus for dynamic studies, earthquake response recorders, etc. This programme has resulted in saving of foreign exchange and in a way helped in creating some confidence and capacity in the country which would eliminate import of similar equipment in future. This may in course of time develop export possibilities.

Long-term studies

As a programme of strong motion studies, similar to the one taken up in other advanced seismic countries, Structural Response Recorder Stations are being built to collect data for the response of idealized structures, during strong earthquakes. Twenty-eight such stations have been established and

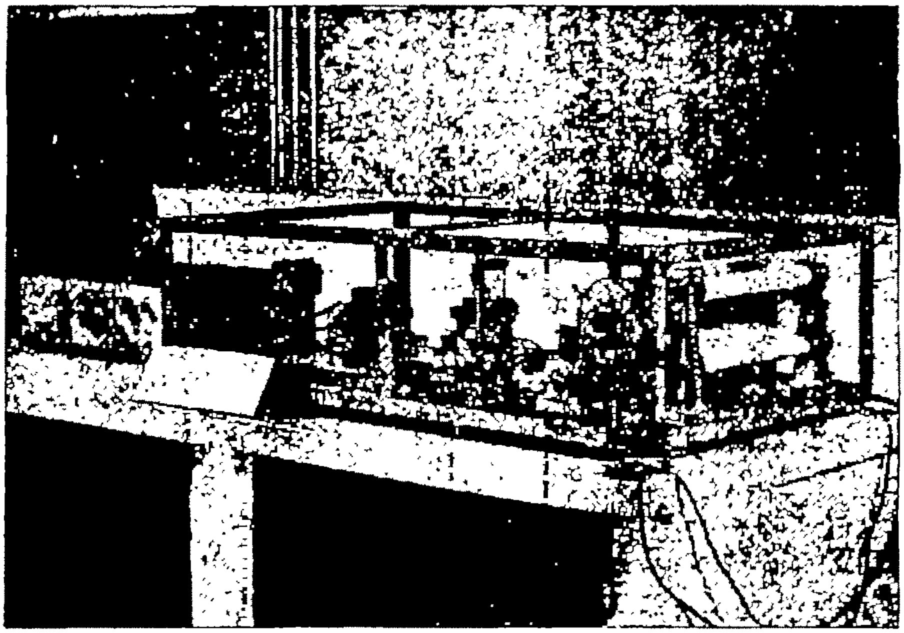

Fig. 4

A strong motion accelerograph designed and constructed at the School to measure strong ground motion

twenty-eight more are expected to be completed during the year 1967. The first strong motion records have been obtained during the earthquake of June 6, 1966, on the instruments installed in Srinagar and Gulmarg. The data has given useful results.

Training

In addition to the research work, the staff of the School also impart training to the trainee officers of specialist courses at this University and outside institutions. The School works as a Post Graduate Department of the University for teaching two years Master of Engineering Course in Earthquake Engineering.

Symposia

The School organized the Third Symposium on Earthquake Engineering in November 1966. The first one was held in 1959 and the second in 1962. Fifty-six papers were contributed at the Third Symposium from India and abroad indicating the interest that has been evinced in the subject in recent years.

Consultancy service

With the facilities of instruments, experimental techniques and computational work now being available, the School has developed into a competent consulting organization which is expected to curtail the necessity of importing experts from foreign countries on problems concerning behaviour during earthquakes, dynamic studies of structures and their foundations, etc. A list of shaking table facilities, dynamic pick-ups and computer programmes that have already been prepared are given below.

1. Shaking tables

There are a number of shaking tables available in the School.

(i) *Large size shock table*

This Table is of size 16 ft. × 9 ft. in plan. The frequency of vibration is controlled by a beam spring. The table is excited by the impact of a freely falling pendulum.

(ii) *Medium size vibration tables*

There are two tables, one of size 200 cm. × 150 cm. and the other 180 cm. × 120 cm. in plan. The frequency of vibration is controlled by coil springs. The tables could either be excited by the impact of a freely falling pendulum or given a steady state sinusoidal motion by means of mechanical oscillators.

(iii) *Steady state vibration tables*

There are two tables. One of size 105 cm. × 60 cm. has a horizontal motion and the other of size 45 cm. × 37 cm. has a vertical motion. The tables are driven by means of eccentrics. The amplitude of the motion could be varied by changing the eccentricity.

2. Speed variation units

D.C. Motors of capacity 1.5 h.p., 2 h.p., 3 h.p. and 5 h.p. are available. Speeds of these are continuously variable by using speed control arrangements of various capacities.

3. Picks-ups for dynamic measurements

Several pickups have been designed and fabricated. Their specifications are given below:

(i) *Accelerometers*

They operate on the principle of variable air gap reluctance.

Maximum range	...	± 12 g with stops set at approximately ± 15
Useful frequency range	...	D.C. to 100 cycles per sec.
Natural frequency	...	200 cycles per sec. undamped
Nominal impedance per oil	...	40 microhenry, 120 ohms D.C.
Typical carrier		3 volts r.m.s. at 2 kilocycles
Mounting base	...	5 cm. × 3¼ cm.
Height	...	3 cm.
Weight	...	70 gm.
Sensitive axis	...	Normal to the base
Mounting position	...	Any

This requires auxiliary instrumentation in the form of universal amplifier and recorder.

(ii) *Velocity pick-ups*

This is a self-generating pick-up in which a coil moves in a permanent magnetic field and the voltage output is proportional to the relative velocity between the magnet and the coil.

Size	45 cm.×20 cm.×24 cm.
D.C. resistance of coil	4,200 ohm
Useful frequency	2 cycles per sec. and above
Natural frequency range	0.75 cycles per sec.
Auxiliary instrumentation required	D.C. amplifiers and recorders

(iii) *Displacement pick-ups*

This instrument operates on the principle of linear variable differential transformer.

Size	40 cm.×20 cm.×24 cm.
Undamped frequency	0.75 cycles per sec.
Frequency range	2 cycles per sec. and above
Sensitivity	180 my per mm. when input is 2 volts
Range	2 kilocycles
Auxiliary instrumentation	5 mm.
Universal amplifier and recorder	Required

4. Computer programmes

Digital computer programmes are available to determine natural frequencies of vibration, mode shapes, response determination using mode superposition methods and also for actual recorded ground motion. Response could be determined for various types of structures, namely, multistoreyed structures, chimneys, storage structures, arches, dams, intake structures, etc.

Conclusion

It would thus be seen that during the Third Five-Year Plan the School has given useful service to the nation resulting in import substitution and saving of foreign exchange by devising instruments for earthquake engineering and seismological studies. The most significant contribution made by the School is devising methods of strengthening brick buildings at a small additional cost. The method is now being adopted for use in India at many places and has received appreciation abroad. These recommendations are being included in Indian Standard Code of Practice of Earthquake Resistance Building Construction.

It is hoped that with the programme of expansion and development during the Fourth Five-Year Plan, the School will have developed itself to a high level of performance and capability.

ADDRESS OF THE CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Jammu & Kashmir Centre

Chairman's address by Shri P. N. Wanchoo, B.A. (Hons.), B.Sc. (Engg.), M.I.E., at the 2nd Annual General Meeting of the Centre on May 20, 1967

After welcoming the Chief Guest, Shri Mir Ghulam Rasool, Retired Chief Engineer and Ex-Development Secretary, J & K Government, and other invitees, notably Shri R. S. Jaiswal, M.I.E., Minister of Public Works Department and Transport, Shri Wanchoo thanked the Committee of the Centre for electing him Chairman for the ensuing year.

Delivering his Chairman's address, Shri Wanchoo said,

On an occasion like this, it will not be inappropriate to express a sense of joy, pride and satisfaction of our being a part of one of the largest technical bodies of the country representing all branches of engineering. The membership of this body exceeds 60,000. Its Corporate Members are working in various capacities such as ministers, members and advisors in planning bodies, chairmen and managing directors in private and public sector industries, research workers, consulting engineers, educators and other executives in the field. We cannot, therefore, afford to alienate ourselves from the profound and pulsating spirit of this body throughout the length and breadth of the country. It is a pride and privilege of the engineers to be engaged in the promotion of technology and nation building activities, as in the final analysis they are chiefly responsible for ameliorating the lot of the common man.

It has been estimated that over Rs. 15,000 crores will be spent on engineering projects and their maintenance during the current Plan in the country. Even in our State, about 70% of the total Plan outlay will be consumed by engineering projects. In view of the rugged terrain of our State and the fact that the projects are larger in number but spread out in difficult regions, the execution of these efficiently and economically is a challenge to our profession, and it is our bounden duty to apply ourselves to this task with devotion, and to contribute all the skill and ingenuity that we may possess.

Our responsibilities in execution of these projects are great and we have to work ceaselessly and selflessly for achieving the targets. That the implementation of a developmental Plan requires sustained efforts on the part of the Nation as a whole goes without saying, but the fact remains that the field engineer has to play the key role in these activities. With all this, he has to bank upon unabated support and help from other bodies. The engineer's work in the field has to be restricted to his profession and he has to be relieved of as many extraneous responsibilities as possible to bring out the best in him. Therefore for implementation of development schemes, it is necessary that a system of coordination by all the bodies concerned is established.

In the execution of our development plans the main reason for shortfalls in our expenditure have been due to this missing link. The present planning body in the State is more or less of an administrative character. Establishment of a suitable body or board to coordinate the activities of the various departments both administrative and engineering will go a long way in speedy implementation of projects.

As nearly 40% of the Plan outlay pertains to programme of building construction it is necessary that our construction programmes are well-planned, well-designed and properly constructed. High cost of buildings adversely affects the scope and economy of planning for larger development projects. It is, therefore, necessary that constructional programmes receive adequate attention at all stages, *viz.*, those of planning, design and construction. The establishment of a suitable body will prove of immense value in this direction.

The question of high cost of the buildings was also discussed in a Seminar organized by our Institution and recommendations of the Seminar have since been forwarded to the Government.

The main recommendations of the Seminar are reiterated here:

(i) The importance of improving functional planning of building has to be greatly emphasized. The engineers and architects have to join hands for evolving suitable design for adoption in the field. For this purpose it is necessary to determine how best the traditional style of architecture of Kashmir could be made use of in the present day buildings to produce a harmonious and functionally sound designs, keeping in view the minimum standards of healthful living.

(ii) The most urgent need of the hour for the public sector is to enter into the field of material manufacture in a big way. The manufacture of materials needs to be mechanized.

(iii) Emphasis has in particular to be laid on advance planning and need for preparing designs with plants, specifications and estimates before any works are taken up for execution.

(iv) Measures for reduction of transport rates are necessary. The provision of an inland railway line in the valley, mechanization of boat transport and liberalization of road transport rules are the needs of the present day.

(a) Methods of construction and management of works need to be reviewed. The engineers should have necessary encouragement to introduce modern and in the long run, inexpensive method in the field.

In order to improve the management of works refresher courses and study tours for field engineers be arranged from time to time within the country and abroad so that they may become familiar with the modern management techniques and utilize the experience so gained advantageously in the construction industry.

(b) The importance of the training of private artisans and skilled department workers at all levels, and infusing a sense of discipline in them has to be given due weight.

Our road construction programme has been successfully implemented but it is difficult to apply the same norms of total road mileage in our State as are being applied elsewhere, mainly because of the absence of a rail link. Our programme has not only to cater for opening up of new areas and linking of new villages but also upgrading the existing roads and bridges to keep pace with the increase in loads to be carried thereon. While it is necessary to frame a schedule for upgrading our State highway and major district roads, it would be desirable that our bridges are designed initially for higher loadings. The question of designing the bridges for lower loadings at the cost of time therefore has to be properly considered.

Our irrigation programmes are limited due to the sub-mountainous terrains, where most of un-irrigated lands are located. The cost of irrigation per acre is naturally very high. But in spite of these limitations there is great need for consolidation of the existing irrigation arrangement and improvement and expansion of minor irrigation works. It is easy enough to build a new irrigation work but the engineer's responsibility is far greater in the proper maintenance of these works for optimum use of irrigation water. The other aspects that need greater attention on our part is the proper utilization of water carried by irrigation canals so that there is maximum yield from crops and the damage to land by waterlogging is minimised. The need for greater cooperation between the agriculturist and the engineer is paramount in this regard.

An agricultural survey for development of the unirrigated areas has to be undertaken to evolve a suitable crop pattern, keeping in view our water resources. Such a survey if done would be a good thing.

Development of irrigation by tubewells in the higher and Kandi regions of the State has been talked about for some time but more needs to be done to keep plans ready for implementation as soon as larger supplies of power are available.

The scheme for reducing intensity of floods in the valley and thereby minimising the area of inundation as well as the period of submergence is under execution and it has already started paying dividends.

The lack of adequate power supply presents a serious bottleneck in the industrial development of the State. The engineers who are charged with the responsibility of constructing new hydel projects and also those who are not connected with it directly have to realize this important point and improve on their targets to shorten the period of completion by various means at their disposal. These are fit programmes in which tools like work study and PERT diagrams would optimize the operations at site through advance planning and better management.

An integrated Master Plan for the layout of our capital cities and towns has to be prepared. No doubt, this is a task which will be costly and time-consuming. We cannot however postpone it any longer and allow the present piece-meal and haphazard growth in absence of overall development plans with provision for drainage, sewerage and other public health amenities.

The cheapest method of transport within the valley is that of inland transport. So far hardly any improvement in this obsolete method of transportation has taken place. The transport charges which have gone high have also not proportionately reflected in the living standards of those who depend on this transport. The development of inland transport has to be started and preliminary investigations and studies taken in hand.

Other ways of carrying loads such as track-ways, etc., as distinct from roadways have yet to be explored.

As the tempo of our developmental programmes goes high the research activities will play an increasing role in the modern practice of engineering. There is therefore an urgent need that our research centres are re-organized and strengthened so that it is possible to deal with local programmes of responsibility and trust reposed in him by his countrymen.

The engineer makes his presence felt in each and every activity of the nation. Naturally, with the advancement of science and technology on one side and multiplication of problems due to all round development on the other, his skill and integrity will be put to test even more rigorously in times to come. There is a pressing need to execute important and urgent works by the engineer in the most economical manner with full awareness of his responsibility and trust reposed in him by his country men.

In this context there is an imperative need to give a technical bias to our administrative machinery, and to cure it of excessive dependence on administrative wizards who claim to be specialists in all matters. Our experts have to be more and more in charge of the development programmes. This is specially necessary in our State where the best of our young men trained in science and technology face peculiar conditions of work, and within a few years the brightness of many of these young people fades away. This can hardly be the way to get the best out of our young talent. Emoluments apart, we have to value the esteem and opportunity available to our young engineers.

Whilst there is no doubt that the engineer has to continue to measure up to the situation, it is imperative that he is given a free hand in planning and execution. He cannot and should not be allowed to work under a mist and in an atmosphere of mistrust. By this, his best efforts turn out to be feeble and far removed from the growing needs and challenging aspirations of the people. There is no justification for accepting the time honoured theory that the engineers must not be burdened with administration due to their shortage in number, or that a generalist is better qualified to run a technical department because of his emotional detachment. This is a glaring injustice in face of the common knowledge that only the best students take to professional studies—mostly engineering. Throughout the training period and even thereafter in the field, an engineer has to deal with men and material and he gains ample experience in management and organization, An engineer is therefore best suited to control and administer all the undertakings directly without any intermediary to hamper the progress at every stage. In this behalf we can best emulate the example of such countries which have developed their economy rapidly more or less under similar conditions as ours. One of the most successful of them is the U.S.S.R., where the economy was in a worse state than ours only four decades back. Today by giving the highest importance to engineering and technology at all levels, it has made astounding strides towards progress and prosperity. Similarly amongst the developing countries the example of the U.A.R. is most glaring.

Recently, the Government has appointed the Administrative Reforms Commission and it is a matter of gratification that the Institution of Engineers (India) have espoused the cause of engineers very ably and eloquently before them. The then President of India, Dr. Radhakrishnan, in his report to the University Education Commission as early as 1949 had emphasized that the ideal head of a big organization should be an executive who is an engineer. He said, 'Although some of such organizations were headed by Administrators who have done their job well, there have been many failures or cases of gross mismanagement. It is preferable that engineers and scientists are heads of departments in such business.'

Before concluding, I would like to point out that our young engineers passing out from the institutions and colleges require practical experience before being entrusted with the execution of important projects. For this purpose there needs to be a close liaison between the engineering institutions and the various wings of the P. W. D. The apprentice engineers form the most sensitive link in the chain and as such they should not be treated flippantly. In fact an onerous responsibility devolves on the senior engineers under whom these budding engineers receive their practical training. Let us consider them as a sacred trust and make them feel their significance, so that they are not overtaken by frustration and diffidence. Most of them are bright students and it is only by dint of their brilliant academic career that they are able to get admission into the engineering colleges. They would, therefore be most receptive to the Code of Ethics laid down by the Institution of Engineers, which I commend to all the fellow engineers.

I once again thank you for having taken the trouble of coming and gracing this occasion. Let me conclude by quoting some of the commandments of the 'Upanishads'

—Practice Righteousness
—Cease not to study and teach
—Discharge your duties to the Gods and your ancestors
—Give with grace
—Give with modesty
—Give with humility'

Summaries of Papers Published in the Journal, vol. 47, no. 12, pt. EL 6, August 1967

ELECTRICAL ENGINEERING DIVISION

621.3.015.5.001

1. Investigations on the Effect of High Humidity on Power Frequency Disruptive Discharge Voltage Between Spheres. Dr. B. Chaudhuri, *Non-member.*

The disruptive discharge voltage of various sphere gaps have been exhaustively investigated in various laboratories of the world and standard values have been published by various national standards organizations and also by the International Electrotechnical Commission. These investigations were, however, carried out in ambient laboratory atmospheric humidities and unfortunately the humidity of the air in these various laboratories during the experimental calibrations were not usually recorded. It is generally recognized that the disruptive discharge voltage of a sphere-gap increases with increasing humidity of the air. But since the numerical values of the humidity effects are not yet investigated, no correction factors for humidity on the disruptive discharge voltage of sphere gaps are given at present. This paper reports on the results of investigations on the disruptive discharge voltage of sphere gaps with spheres of diameters 5 cm. and 15 cm. with 50 cycles per sec. power frequency voltage at absolute humidities from about 14 gm. per m.^{3} to 32 gm. per m.^{3}, ambient dry bulb temperatures varying from 29°C. to 36°C.

621.313.36

2. Unbalanced Operation of Polyphase Commutator Motors. P. K. Dash, *Non-member.*

In this paper, the operation of a polyphase commutator motor working on an unbalanced voltage on the stator side, but balanced voltages on the rotor side has been discussed. The modified α, β, 0, or the Hwang components have been utilized to formulate the basic voltage and current equations under unbalanced conditions. The operation of the machine under normal balanced voltage has been compared with that during unbalanced operation.

621.315.1

3. Trends in High Voltage Transmission. Dr. M. Datta, *Member.*

With the continued growth of electricity, the generating stations are geographically moving away from the load centres and the design of high voltage transmission system to link the power stations as well as to supply power to the consumers' premises involves economic study of capital and running expenditure apart from considering the technical limitations. The selection of system voltage and conductor size, use of autoreclosing circuit breakers insulation co-ordination, stability considerations, etc., have been briefly discussed in the paper. Also, the trend of development of high voltage power systems in different countries and the scope for development in India and the necessity of a National Power Grid have been outlined.

621.313.334

4. Performance of Twin Stator Induction Motor. I. Gopal Reddy, *Non-member,* **and A. Subba Rao,** *Non-member.*

A degree of speed variation is possible by physically rotating one set of stator windings, with respect to the other, of a 3-phase squirrel cage induction motor having two independent sets of stator windings. An analysis of performance of such a motor is made in terms of the space angles between the stator and rotor magnetomotive force waves.

621.372.4

5. State-Variable Equations of Linear Networks. Dr. V. K. Jain, *Associate Member,* **and S. C. Rastogi,** *Non-member.*

In this paper, a technique has been developed by which the state equations of a network can be written by inspection. The state variables are the charges and currents in the mesh network. The simplicity of the method is enhanced by the fact that a resistance-inductance-capacitance series combination is treated as one edge, rather than three separate edges.

621.52.001

6. Relative Stability Studies for a Certain Time Lag System. S. Mukherjee, *Non-member,* **and S. Das Gupta,** *Member.*

This paper deals with the relative stability problems associated with a second order servo system with transport lag. The analysis is made essentially by following root locus techniques according to Yaohan Chu and a set of universal relative stability curves are obtained. It is a simple matter of changing scales so that this set of relative stability curves may also be used for any other value of controller time constant. An example, shown in the paper is of some help in the design of second order systems with transport lag in regard to gain, damping ratio, motor time constant and the dead time lag.

621.315.1.001

7. Prospects of Tuned Power Lines in India. K. Nagaraja Naidu, *Associate Member,* **and V. Thenappan,** *Non-member.*

The task of the present-day power engineers is to investigate new methods of transmitting large blocks of power over long distance so as to meet the rapid load development and utilize the remotely located low cost energy resources. Tuned power transmission is a proposed system in which the line length is electrically increased to be more than one-half wavelength (3,000 km. at 50 cycles per sec.) by suitable tuning equipment. In doing so, the system is found to be more stable and free from some of the long line problems. In this paper, the possibility of establishing such a system in this country is indicated. The new system is illustrated by designing a hypothetical line of 500 kV, 1,800 km. and its characteristics and behaviour during normal and abnormal conditions are presented after a preliminary study of the system in A.C. network analyzer.

621.372.4

8. Application of Root-Locus Concept to a Class of Non-linear Systems for Time Solution. P. R. Naidu, *Non-member,* **and Dr. S. Das Gupta,** *Member.*

This paper gives a method of solving a class of non-linear problems by root-locus concept. The non-linear system is assumed to be linear for a short interval of time, and so the same inverse transform is utilized to get the time response, taking the initial conditions into consideration. The important points to improve the accuracy of the method are outlined and the critical stages are discussed.

621.3-503 .621.372

9. Analysis of Steady State Stability by Liapunov's Method. Dr. J. Nanda, *Non-member.*

This paper deals with the physical and mathematical concept, propounded by Liapunov, in respect of steady state stability, that is the stability under small oscillations.

621.3.503

10. A Root Locus Interpretation of Routh, Nyquist, and Mikhailov Stability Criteria. T. R. Natesan, *Non-member.*

In this paper, an attempt is made to interpret Routh, Nyquist, and Mikhailov stability criteria in terms of the root locus technique and a new method is suggested to determine the transient response of the system. In all the above stability criteria, the s-plane is conformally mapped on the $G(s)$-plane. The root locus is essentially a graphical procedure which plots the $G(s)$-plane on the s-plane. Since there are several values of s satisfying the equation $G(s) = -1$, the mapping from the $G(s)$ plane on the s-plane is not entirely one to one. Examples are given to illustrate how the root locus stability criterion compares with stability standards based on the usual frequency response methods and the data to plot the phases and gain constant contours were obtained using IBM 1620 electronic digital computer.

621.311 :621.3 027

11 Power Density Spectra of a Power System. N. Rama Rao, *Non-member,* **and K. S. Prakasa Rao,** *Non-member.*

This paper analyzes the power density spectrum of the voltage function of a power system. The voltage function is approximated to a frequency modulation process when the load is assumed to be a stationary Gaussian type of function.

621.316.1.001

12. On the Analysis of Networks Using the Theory of Directed Graphs. Dr. P. V. Ratnam, *Non-member,* **and G. Govinda Rao,** *Non-member.*

In this paper, the loop current and node voltage concepts conventionally utilized for solving electrical networks are mathematically established from first principles, using the theory of directed graphs. The significance of inverting non-singular submatrices of the matrices of a directed graph is also discussed in some detail, in its relation to the analysis of electrical networks.

621.313.126

13. A. C. Excitation Systems. Dr. T. N. Saha, *Non-member.*

Since the present trend is to increase the rating of individual generating unit, due to better cooling system and other technical improvements, the excitation power requirements also rise consequently. The D.C. exciters may not economically meet this requirement and therefore, A.C. excitation systems using rectifiers, both static and rotating types, are being increasingly used. The various aspects of rectifying unit used with A.C. excitation system namely current and voltage ratings, protection of rectifiers, etc., and also the performance of A.C. excitation system have been discussed in this paper.

621.313.001

14. Flow Graph Theory—a New Approach to the Analysis of Electrical Machines—Part 2. L. B. K. Sastry, *Non-member.*

The Part 1 of the paper (*Journal,* Vol. 47, no. 8, pt. EL 4, April 1967, p. 340) described the fundamental properties of linear flow graphs and their application to the analysis of 3-phase induction motors. The objective of this part is to describe equivalent flow graphs to some of the non-linearities most often encountered in the analysis of electrical machines and to illustrate the application of the flow graph technique to the analysis of 3-phase uniform air gap machines, possessing much non-linearities in the fundamental equations. This method of approach eliminates transformation of fundamental differential equations to simpler differential equations of performance and enables to obtain the desired performance practically by inspection of the flow graph representing the machine.

621.313.334

15. Flow Graph Theory—a Study of Induction Motor Performance. L. B. K. Sastry, *Non-member,* and C. K. Sarma, *Non-member.*

In this paper, the fundamental properties of the signal flow graphs are described and the signal flow graphs technique is used to obtain a flow graph model for the three phase induction motor. When specific input voltages are given to the induction motor, the output currents can be directly obtained by inspection of the graph structure. Based on the above analysis, the steady state as well as transient performance of the machine are predicted for different assumed operating conditions. The performance characteristics of the induction motor obtained by this method are compared with those obtained from the conventional circle diagram as well as direct load test. The results obtained by this method are found to be more accurate compared to those obtained from the circle diagram.

621.316.728

16. Reactive Power Control by State Equipment. Prof. T. V. Sreenivasan, *Associate Member.*

Shunt capacitors and reactors are used for reactive power compensation in power systems. But no easy means are available to control this compensation, and thereby, affect voltage control of power systems, which has become the prerogative of synchronous phase modifiers. Shunt saturated reactors are not used permanently in the system for fear of introducing harmonics. Now saturated three phase reactors have been evolved, which have good wave shape. Slope-corrected saturated reactors have also been evolved and the problem of instability is being solved. It is suggested that D.C. controlled reactors have also an useful role to play. The reactive power can be controlled better with lesser losses. Some test results about reactor characteristics, harmonics, losses and D.C. control current are presented.

CALCUTTA

INSTITUTION NOTICES

Distribution of the *Journal* and the *Bulletin* to Members of the Institution

It is being notified for the information of all members that the free distribution copies of the *Journal* and the *Bulletin* will be sent to all categories of members only in accordance with the stipulation of Resolution 57 of the 449th Council Meeting held in Srinagar on May 27, 1967, which is quoted below:

> 'Resolved that the supply of the *Journal* and the *Bulletin* to members, who are in arrears of subscription according to Regulation 56 and if such arrears are not paid by the last day of February following, be stopped as provided in that Regulation.'

For convenience, Regulation 56 is quoted hereunder:

> "Any member in any class whose subscription for the current year shall not have been paid before the first day of November shall be 'in arrears of subscription'. If such arrears are not paid by the last day of February following, he shall not be entitled thereafter to receive publications of the Institution as described in Regulation 65, or upon making such payment at a future date to receive the back publications for the period between the last day of February and the date of his making payment."

Proceedings of the Seminar on the 'Role of the Engineer in the Fourth Five-Year Plan', Patna, January 30-February 3, 1966

The Seminar on the 'Role of the Engineers in the Fourth Five-Year Plan' was held concurrently with the 46th Annual Convention of the Institution at Patna from January 30-February 3, 1966. The engineers of the country responded enthusiastically and a large number of papers were received by Brigadier M. K. Rao (M.) who was the Convenor of the Seminar.

The discussions in the Seminar, held in four sessions were belonging to the following topics: (i) Organization, (ii) Management and Productivity; (iii) Resources, research and development; (iv) Power and irrigation; (v) Development projects; (vi) Agriculture and (vii) Communications and miscellaneous. The *Proceedings* also embodies the complete details of discussions made and speeches delivered by eminent engineers and statesmen to lay the guidelines of 'The Role of the Engineer in the Fourth Five-Year Plan'.

Copies of the *Proceedings* are now available for sale. Priced at Rs. 20.00 per copy, the volume will carry a companion volume of the General Engineering Part of the *Journal* for September 1966 (price Rs. 2.50 per copy) containing 17 papers presented at the Seminar.

Draft Indian Standards

The following draft Indian Standards have been issued recently.

1. Draft Indian Standard Method of Test for Determination of Permeability of National Building Stones—Doc: BDC 6 (1252).

This standard covers the method for determining the permeability of natural building stones.

Members may send their comments on this draft standards before September 10, 1967, to Shri T. R. Mehandru (*M.*), 14 Asaf Ali Road, Ajmeri Gate Extension, New Delhi, who is the Institution representative on the Sectional Committee dealing with this standard.

2. Draft Indian Standard Methods of Test for Stabilized Soils: Part 1—Methods of Sampling and Preparation of Stabilized Soil for Testing—Doc: BDC 23 (1250); Part 2—Determination of Moisture Content of Stabilized Soil Mixtures—Doc: BDC 23. (1243); and Part 3—Determination of Moisture Content Dry Density Relations of Stabilized Soil Mixtures—Doc: BDC 23 (1240).

Part 1 of the standard lays down the general principles of samples for obtaining disturbed samples and the method for preparation of stabilized soils for testing; Part 2 lays down the method for the determination of moisture content of stabilized soil mixtures with non-volatile stabilizers and with volatile stabilizers; and Part 3 lays down the method for the determination of the relation between the moisture content and the dry density of a stabilized soil mixture.

Members may send their comments in this draft standard before September 20, 1967, to Shri C G. Swaminathan (*M.*), Assistant Director, Central Road Research Institute, New Delhi 20, who is the Institution representative on the Sectional Committee dealing with this standard.

3. Draft Indian Standard Method of Test for Chemical Resistant Mortars: Part 1—Silicate Type and Resin Type—BDC 5 (1981); and Part 2—Sulpher Type—Doc: BDC 5 (1299).

Part 1 of the standard covers the methods for carrying out the following tests on silicate type and resin type chemical resistant mortars; and Part 2 covers the methods for carrying out the tests on sulpher types chemical resistant mortar.

4. Indian Standard Code of Practice for Use of Silicate Type Chemical Resistant Mortars—Doc: BDC 5 (1082).

This code provides recommendations for storage mixing and use of silicate type mortars for bonding chemical resistant masonry units in order to obtain optimum chemical resistant masonry units in order to obtain optimum chemical resistance and physical strength of mortar.

5. Indian Standard Code of Practice for use of Sulphur Type Chemical Resistant Mortars Doc: BDC 5 (1083).

This standard provides recommendations for the storage, melting, method of use and safety precautions to be taken in handling sulphur mortars.

6. Indian Standard Code of Practice for use of Resin Type Chemical Resistant Mortars—Doc: BDC 5 (1084).

This code provides recommendations for the storage, mixing, method of use and safety precautions in handling resin type chemical rseistant mortars.

Members may send their comments on this draft standard before September 25, 1967, to Shri C. P. Malik (*M.*), Additional Chief Engineer (Vigilance), C.P.W.D., Room 135, Nirman Bhawan, New Delhi 11, who is the Institution representative on the Sectional Committee dealing with this standard.

Copies of the draft Standards may be obtained from the office of Indian Standards Institution, 'Manak Bhavan', 9 Bahadur Shah Zafar Marg, New Delhi 1, or from its branch offices at Bombay Mutual Terrace, Sandhurst Bridge, Bombay 7; 5 Chowringhee Approach, Calcutta 13; 14/69 Civil Lines, Kanpur, or 54 General Patters Road, Madras 2.

Exchange of Membership Guest Privileges

A letter received from Dr. G. F. Gainsborough, Secretary, The Institution of Electrical Engineers, Savoy Place, London, is reproduced below for information of members.

Our ref. CL. 3930 20th June 1967

Mr. R. N. Banerjee,
Secretary,
The Institution of Engineers, India,
8, Gokhale Road,
Calcutta 20,
India.

Dear Mr. Banerjee,

During my recent visit to India reference was made in conversation with you and others to the reciprocal granting of facilities to the members of an engineering Institution when temporarily visiting another country.

I am happy to confirm that such reciprocal arrangements for the extension of privileges to visiting members are already in existence between this Institution and a number of kindred Institutions in other countries, including your own Institution, and all the other constituent members of the Commonwealth Engineering Conference.

Generally, the privileges under the scheme include attendance at meetings, visits and social functions and use of the library, and it is customary for members wishing to avail themselves of these facilities to be accredited by letters of introduction or similar documents from their Institutions.

Yours sincerely,
(Sd.) G. F. Gainsborough
Secretary

Members who will visit the U.K. and are interested in availing of the privileges of visiting members may contact the Secretary for a letter of introduction to the Secretary of the Institution of Electrical Engineers, London.

Misdemeanour in the Institution examinations

The Council have decided to cancel the results of the following candidates for the November 1966 examinations and debar them from appearing in the Institution examinations up to and including that mentioned against each name.

Studentship No./ Studentship Application Ref. No.	Roll No.	Name	Debarred upto and including
69711-S	294ST	Kashmiri Lal Kalra	November 1967
65109-S	355ST	C. V. Ramakrishnan	November 1967
58159-S	366ST	K. K. Kapoor	November 1967
S.69718	3569A	Avtar Singh	November 1967
S.54946	10727A	Satya Paul Magoo	November 1967
72757-S	828ST	M. P. Chacko	May 1968
S.58781	8715A	N. N. Gohain	May 1968
S.44355	297B	Gulab Das Burman	May 1968
S.40952	477B	Suresh Chandra Gupta	May 1968
S.44667	1788B	B. B. Sharma	May 1968
S.41684	2959B	V. Y. Salunke	May 1968
S.36171	3110B	Pulakananda Baksi	May 1968
S 30218	3500B	Balbir Singh	May 1968
S.30220	3502B	Inder Paul Magoo	May 1968
S.31251	3508B	Prem Kumar Sharma	May 1968
S.29926	3515B	Karm Paul Singh Mann	May 1968
S.68268	8252A	K. D. Misra	May 1968
S.68894	8254A	V. P. Goel	May 1968
S.31427	2062B	Chand Krishan Sobti	May 1968

The result of Shri B. B. Hirde (S. 49625), Roll No. 9304A was cancelled for the November 1966 examination only.

INSTITUTION NEWS

Opening of Guest Rooms in the Headquarters Office

On July 14, 1967, the President, Maj. Gen. S. P. Vohra, declared open the Guest Rooms in the Headquarters Office of the Institution. A photograph taken on the occasion is given below. These rooms are situated in the annexe building of the old headquarters office and are provided with all amenities.

President meets Headquarters staff

The President, Maj. Gen. S. P. Vohra paid an official visit to the Headquarters office on July 14-15, 1967. On July 14, he met the staff at the Sir R. N. Mookerjee Hall. While addressing the staff, he said that the members of the Institution are expecting maximum benefit from the Institution. So, it is the responsibility of the staff to provide them with the necessary assistance sought for and replies to their queries promptly. Some members of the staff put forward their demands to the President who assured them

THE PRESIDENT, MAJOR GENERAL S. P. VOHRA, OPENING THE GUEST ROOMS

that he would look into the matters in consultation with the Finance Committee. The meeting ended with a small tea party.

President visits Andhra Predesh Centre

The President, Maj. Gen. S. P. Vohra visited the Andhra Pradesh Local Centre on July 17, 1967. Shri O. Thimmaiah (*M.*) Chairman of the Centre welcomed the President, and thanked him for having agreed to visit the Centre after inaugurating the Sub-Centre at Visakhapatnam on July 16, 1967.

The President addressed the members and said that Visakhapatnam is one of the biggest industrial areas in India, and hence the Sub-Centre at Visakhapatnam has to play a great part in developing the activities of the Institution. He informed the members that an amount of Rs. 20,000 was sanctioned for the construction of a building at Visakhapatnam for the Sub-Centre. He appreciated the excellent arrangements made for the inauguration of the Sub-Centre at Visakhapatnam by the Chairman and Honorary Secretary of the Sub-Centre and their team work. He also appreciated the work done by the Chairman and Honorary Secretary of the Andhra Pradesh Centre for the growth of membership of the Centre and improving its activities.

The President, Major General S. P. Vohra, Engaged in Conversation with Headquarters Staff

The President then explained the need and importance of professional bodies. He stressed that these professional bodies shall improve the standards of engineers in their engineering activities. He also explained the importance of holding technical symposia during the Council Meetings.

The President requested the senior members to help students for coaching them to appear for the Institution examinations on voluntary basis. Even though there are many private institutions giving coaching to students, they have become commercial institutions instead of organising bodies. Hence he stressed the need to sponsor some concrete proposals to the Government to start coaching institutions or start evening classes for our students and request the universities and other Government institutions to spare the laboratories, workshops, drawing rooms, etc., during evening times for their use.

A dinner was arranged in honour of the President at the Institution building and was attended by the Committee and a few senior members.

Urban Explosion: U.S.A.-India Exhibition, Bangalore, June 17-22, 1967

The 'Urban Explosion: U.S.A.-India Exhibition', sponsored by the American Cultural Centre, Bangalore, was held in the premises of the Mysore Centre of the Institution in Bangalore from June 17-22, 1967. Inaugurated by Shri R. M. Patil, Minister for Municipal Administration, Government of Mysore, the Exhibition dealt with the problems of growing cities including Bangalore. During the inaugural ceremony, the Minister for Municipal Administration released the report on the Seminar on 'City Architecture' conducted by the Mysore Centre in December 1966. The report contains papers presented at the Seminar and recommendations on how Bangalore can be developed.

Design Engineers' Forum, Mysore Centre

The interest created by a seminar on 'Creative Engineering', organized by the Mysore Centre in December 1966, has enthused the design engineers in several local industries to come together for discussing the problems of design engineers in the context of utilising their services fully in the development of the country under the forum of the Institution. Accordingly, a few senior design engineers recently met informally and proposed to form a forum called Design Engineers' Forum for fostering the activities of the design engineering in particular. It was felt that this Forum could help foster the study of the special problems of design, material sciences and new developing technologies, establish liaison with educational institutions and technical journals and also develop design consultancy in addition to publishing articles on design problems. The Forum will bring out periodic design data sheets for publication which would be useful to the design engineers.

Asansol Sub-Centre

At the 449th Meeting of the Council held at Srinagar from May 26-27, 1967, the Council has decided that a Sub-Centre of the Institution be opened at Asansol, West Bengal. It is expected that the new Sub-Centre will be formally inaugurated during the second week of August 1967

Change of name of Punjab Centre

The Council at its 449th meeting held at Srinagar in May 1967 has resolved that the nomenclature of the Punjab Centre be changed to Punjab, Haryana and Himachal Centre.

History of Ancient Indian Technology

A Meeting of the Panel appointed to publish report on the History of Bharatiya Technology was held on Friday, June 30, 1967, at 6-15 p.m. in the Bombay Centre. The following were present: (1) Shri J. G. Bodhe (in the Chair), (2) Shri R. N. Joshi, (3) Shri R. V. Marathe, (4) Shri C. V. Agashe, (5) Shri D. P. Jog, and (6) Major N. B. Gadre. Shri Jog and Major Gadre had sent their written comments.

At the outset Shri Bodhe introduced the members among themselves and thanked the members present for their attendance.

Shri Bodhe explained the circumstances under which the Institution of Engineers (India) had appointed this Panel and the brief aims and objective. He stated that it was proposed to publish a small volume of about 300 to 400 pages giving in brief, History of the evolution of Bharatiya Technology from ancient times, *i.e.*, 2000 B.C. to the comparative modern times (till the beginning of the British era). He suggested that a phased programme be chalked out for the preparation of the volume which should be complete within a period of one year. It was necessary to find out the main sources from where ancient publications and materials may be obtained.

The two main sources, among many others, of information were at Nagpur and Delhi, with Shri Ram Ratan Sharma of the Research Institute of Ancient Studies. It was understood that at Delhi there were about 2,000 volumes available for studies in Bharatiya Technology. It was made clear that the publication of the Institution will not be a classical or stupendous volume nor merely theoretical or the translation of some old volumes. It will be a history indicating the evolution of engineering, town planning, architecture, water supply, sanitation, agriculture, defence works, places of worship, monuments and lives of well-known craftsmen and engineers from the ancient to modern times.

Shri Bodhe further informed that the Institution had sanctioned Rs. 10,000 for initial expenses and some additional amount may be obtained later for the printing and other expenses.

After prolonged discussion it was resolved that Sarvashri Jog, Agashe, and Marathe be requested to discuss further necessary steps for visiting Nagpur and Delhi to ascertain the extent of information and sources. It was suggested by Shri Marathe that the list of Books at Nagpur source be made available to them at Bombay. He will decide which of the volumes are useful for our purpose. Shri R. N. Joshi assured of furnishing the list of volumes at Nagpur and it was decided that the above members will visit Nagpur sometime in the next month for getting full details and commencing the outline of work.

Shri Agashe submitted a brief note, indicating various heads under which the work be divided and information collected. The note will be cyclostyled and circulated. Based on this a note to suit our requirement will be prepared and finalised in the next meeting.

It was also resolved that the information should be on the following three items : (1) Materials, (2) Construction, (3) Builders.

The panel was assured that the cyclostyling and typing of all such work will be done by the Bombay Centre Office as and when necessary.

The Sub-Committee was also entrusted to take down notes from the ancient volumes and if necessary to secure publications at reasonably economic cost

The meeting then terminated with a vote of thanks to the Chair.

Shri G. A. Narasimha Rao representing India at Leningrad Symposium

Shri G. A. Narasimha Rao (*M.*), Chief Engineer, Additional Secretary and Administrator (Projects), Public Works Department, Andhra Pradesh, is representing India at the International Symposium on 'Floods and Their Computations' in Leningrad, U.S.S.R., from August 15-22, 1967. A past-Chairman of the Andhra Pradesh Centre and a Council Member, Shri Narasimha Rao has been nominated as Indian representative in the Working Group of International Hydrological Decade His paper on 'New Computation Technique for Probable Maximum Flood Discharge at a Place in the River while Gauge Discharge Data is Available for Another Place with Special Reference to Dams on Krishna River, India' has been accepted for presentation at the Symposium. Shri Narasimha Rao will also take part in the study tours after the Symposium and will visit several important hydraulic and hydrological research stations and works in the U.S.S.R.

Shilpa Wangmaya Sangraha (Indigenous Technical Literature Meseum), Nagpur

The following books have been recently acceeded to the Indigenous Technical Literature Museum at Nagpur.

141. History of Indian and Indonesian Culture. Ananda K. Coomarasamy. *Dover Publications, Inc.*, Rs. 22.50. 1965, 295 pages and 128 plates.

142. History of Indian and Eastern Architecture—vol. 1. James Fergusson.

143. History of Indian and Eastern Architecture—vol. 2. James Fergusson.

New Chairman of the Council of Engineering Institutions

Mr. Leonard Drucquer has been elected Chairman of the Council of the Council of Engineering Institutions (CEI), London. He takes office immediately for a period of eighteen months. He is Director of A.E.I. Automation Ltd., and a member of the following bodies: the Governing Body of the Rugby College of Engineering Technology; the Industrial Electrical Machinery Board of BEAMA; The Institute of Directors and the Iron and Steel Institute. Mr. Drucquer was Chairman of the Supply Section of the Institution of Electrical Engineers in 1955-56 and President 1965-66.

Training of Indian engineers in Japan

Fourteen Indian engineers, on their way to Japan for higher training in electrical engineering, were given a warm send off at the Madras Airport on July 7, 1967, by representatives of Toshiba Anand Lamps Ltd., a company recently started in Ernakulam, Kerala, for the manufacture of GLS lamps and fluorescent tubes. These young engineers, with brilliant academic records and selected from a large number of applicants, will undergo training for six months at the factories of the Japanese Company in various aspects of electrical lamp manufacture.

Ancient Geometry

A book on 'Ancient Geometry' has been published in Denmark. This book reveals the very background to the ageless wonders of forgotten times. Its evidence is found not only in the study of mathematics, but even more vividly in the great memorials and aesthetic remains of past cultures and civilizations. The book is published in two volumes by Ancient Geometry, 41 Nygaardsvej, Copenhagen O, Denmark.

Proceedings of the Symposium on 'Fuel Efficiency in Iron and Steel Industry'

A symposium on 'Fuel Efficiency in Iron and Steel Industry', was conducted by the National Productivity Council, Madras Regional Directorate, at Ranchi, in April 1967. The Proceedings of the Symposium contain important papers on all aspects of iron and steel industry. The Proceedings will be priced at Rs. 60 (approximately). Copies may please be ordered in advance from the National Productivity Council, Regional Directorate, 6 Monteith Road, Egmore, Madras 8.

New 3 cu. yd. tractor shovel

Allis-Chalmens, U.S.A., have introduced a new 3 cu. yd. tractor shovel, model HG-12G, designed for bank loading, stockpile work, basement excavation and medium sized contracting jobs. The 42,760 lb. unit boasts 184 net h.p. at the fly wheel. Low operating cost is a feature of the HG-12G. The unit has low fuel consumption per yard of material moved than most competitive units based on actual on-the-spot tests There are fewer service points with longer intervals

Reduction in building costs

The first meeting of the Guiding Committee for National Building Code set up by the Indian Standards Institution (I.S.I.) was held in New Delhi, on July 17, 1967, under the Chairmanship of Maj.-Gen. Harkirat Singh, Adviser (Construction), Planning Commission. The meeting was attended by over 25 prominent engineers, architects and builders from all over the country.

Addressing the meeting, Maj.-Gen. Harkirat Singh pointed out that buildings accounted for a large proportion of the expenditure incurred on construction by the Centre, States, municipal administrations and various other organizations in the country while the existing P.W.D. and municipal codes laying down criteria for design of buildings and other particulars for incorporation therein, were out-dated. Some of the provisions contained in these codes were wasteful and the codes did not cater to the latest developments in the field of building design construction techniques and materials. An important step towards achieving economy in construction was therefore, the preparation of a National Building Code, which would promote uniformity of building regulations throughout India as was done in advanced countries of the world.

The National Building Code, when formulated, was intended to serve as a complete document containing regulations which might be conveniently adapted or incorporated for use by various departments, municipal administrations and public bodies. The Code would lay down a set of minimum provisions, and designs to ensure the public safety with regard to structural sufficiency, fire hazards and health aspects. It would also permit the use of new building materials and methods of design and construction. The National Building Code would include within its scope the industrialized methods of buildings and system building techniques which have shown considerable promise in other countries and which would result in increased building productivity, thereby showing significant reduction in building cost.

Shri B. S. Krishnamachar, Deputy Director General of I.S.I. welcoming the members of the Guiding Committee to the meeting, pointed out that in the past, the Institution had undertaken successfully some important projects under guidance from the Planning Commission, like Steel Economy Project and Multipurpose River Valley Project. Formulation of the National Building Code would also, he hoped, be feasible with the cooperation of eminent engineers, architects and builders in the country.

The Guiding Committee set up 17 Expert Panels dealing with different aspects of the National Building Code. The work undertaken by the Institution is expected to be completed in about 2-3 years. This Code would be periodically revised so as to be kept up-to-date.

FORTHCOMING EVENTS

Symposium on 'Rocket Technology', Mesra, October 16-18, 1967

A Symposium on 'Rocket Technology' will be held at the Birla Institute of Technology, P.O. Mesra, Ranchi, Bihar, from October 16-18, 1967. An exhibition of posters, models and literature on space era will also be organized during the Symposium. Further particulars can be obtained from Prof. G. B. Pant, Head of the Department of Space Engineering and Rocketing, Birla Institute of Technology, P.O. Mesra, Ranchi, Bihar.

All-India Conference on Quality Control, Madras, December 7-9, 1967

An All-India Conference on Quality Control will be held in Madras from December 7-19, 1967. This Conference is intended to review the current position, discuss problems and consider measures for the wider adoption of modern quality control systems by Indian industries. To provide maximum opportunities for discussions by delegates, the Conference has been designed into five major industry-wise sessions running concurrently besides the plenary sessions arranged for discussion of the common interindustry problems. Papers not exceeding 2,500 words in length are invited for discussion at the Conference. Further details can be obtained from the Conference Secretariat, SQC Unit, 35/5 Mount Road, Madras 2.

Symposium on 'Industrial Measurement Techniques for On-Line Computers,' London, June 10-14, 1968

A Symposium on 'Industrial Measurement Techniques for On-Line Computers' will be organized by the Control and Automation Division of the Institution of Electrical Engineers, with the collaboration of the Institution of Mechanical Engineers and the Society of Instrument Technology under the aegis of the United Kingdom Automation Council. The Symposium will take place at the Institution of Electrical Engineers, London, from June 10-14, 1968. The subjects to be covered include the influence of computers on instrument design and measuring techniques, transmission signals and noise reduction, non linear measurements and correction techniques, new developments in sensors, the use of analytical instruments with computers, the adaption of conventional process instruments for use with computers and the general subject of interface. The Organizing Committee invite intending contributors to submit, in the first place, synopses of approximately 300 words of their proposed contributions by September 30, 1967. Further details can be obtained from The Conference Section, Institution of Electrical Engineers, Savoy Place, London, W.C. 2, England.

IFAC Symposium on Optimal Systems Planning, Cleveland, June 20-22, 1968

An International Symposium on Optical Systems Planning will be held at the Case Institute of Technology, Cleveland, Ohio, U.S.A., from June 20-22, 1968, under the sponsorship of the IFAC Committee on Systems

Engineering. The Symposium will be organized by the American Automatic Control Council in conjunction with the Systems Science and Cybernetics Group of the Institute of Electrical and Electronics Engineers. The Symposium will provide a focal point for the presentation and discussion of (i) Basic methods and theories underlying optimal long range planning of organizations and projects, and (ii) Applications and experiences in these techniques.

In this context, planning will include social and economic as well as technical systems. Studies of current and long term trends as well as the definition of particular problem areas will form part of the Symposium. The range of the Symposium will cover planning methods such as (i) Future demand forecasting, (ii) Assessing planning effectiveness, (iii) Modeling and simulation, (iv) Optimization, (v) Choosing correct methods and (vi) Decision making. Applications and discussions are being sought from a wide range of areas including industrial and manufacturing systems, power systems, educational fields, transportation, banking and business information and communication systems.

Intending authors should send abstracts (200-300 words) on their proposed paper for the Symposium in English by October 1, 1967, to the Chairman of the Program Committee. Further details can be obtained from IFAC Optimal Systems Planning Symposium, c/o. Prof. T. J. Williams, Michael Golden Engineering Laboratories, Purdue University, Lafayette, Indiana, 47907, U.S.A.

IFAC International Symposium on 'Technical and Biological Problems of Control (Cybernetics)' Moscow, October 8-12, 1938

In accordance with the IFAC Executive Council decision in London (1966) and Menton (June 1967), an International Symposium on 'Technical and Biological Problems of Control' is being organized by the U.S.S.R. National Committee of Automatic Control to be held in Moscow from October 8-10, 1968. The Symposium will cover the following major areas of interest.

1. *Technical problems*
    - (i) How to teach machines to differentiate and to classify.
    - (ii) Heustiric programmes (for the simplification of completed calculations with electronic computers, for instance for the solution of strategic games, establishments of proofs, establishment of time-tables, labyrinth search, etc.)
    - (iii) Adaptive systems (alogorithms of simulation of adaptive processes, theory of adaptive systems, etc.)
    - (iv) Simulation of processes of evolution and evolution of artificial systems (growing automata, etc.)
    - (v) Methods for development of reliable systems by using unreliable elements.
    - (vi) Utilization of machines and programmes for teaching man.
    - (vii) Utilization of cybernetic means for the purpose of making protheses (artificial heart, lung, kidney, etc.)

2. *System approach to development of biological aspects of cybernetics*
   - (i) Concept of system in biology and engineering. Role of system approach to formation of cybernetic laws. Classification of biological and engineering systems: 'large scale' and 'small scale' systems, 'hyerarchy of systems'.
   - (ii) Properties and chief mechanisms of biological systems. Laws of their evolution. Possible applications in technical cybernetics.
   - (iii) Functional system as entity of organism's integrating activity. Mechanisms of 'decision-making', 'forecast of results,' information of results' and 'error-suppression'. Use of these mechanisms in construction of cybernetic apparatus.
   - (iv) System approach to study of living organisms adaptation.
   - (v) Study and simulation of higher nervous activity (models of brain, neuron and neural nets).
   - (vi) Physical and engineering methods of receptor activity investigation, theory of receptor. Use of receptor analogues in technology (analyzers, space orientation).
   - (vii) Engineering psychology; 'Man-Computer Man' iteration as prototype of 'large scale' systems.
   - (viii) Use of computers in biological and physiological systems.

Members wishing to contribute papers for the Symposium are requested to submit the abstracts of this contribution to the National Committee of Automatic Control of the U.S.S.R. before September 30, 1967.

Further details can be obtained from the Secretary, The Institution of Engineers (India), 8 Gokhale Road, Calcutta 20.

IFAC Symposium on Fluidics, London, November 4-7, 1968

An International Symposium on Fluidics, sponsored by the IFAC Committee on Components, will be held in London at the headquarters of the Royal Aeronautical Society from November 4-7, 1968. About 30 papers will be presented in six half-day sessions, reporting original work on the following subjects.

BOOK ACKNOWLEDGMENTS

1. **Progress of Technical Education in India.** N. C. Chakraverty. Published by the author, Ministry of Education, Eastern Regional Office, Calcutta, 1966, 102 pages.

This book contains a survey of technical institutions and universities in India together with the development of the Institution region-wise. The annexures included at the end of the book contain useful information such as list of Indian Universities, National Laboratories and Institutes under C.S.I.R., agricultural research institutes in India, etc.

2. **Elementary Engineering Drawing.** N. D. Bhatt. *Charotar Book Stall*, Anand, Rs. 13.50, 7th edition, 1966, 512 pages.

This book covers the syllabi of both the degree and diploma courses in engineering and deals with the fundamental principles of the subject. In this edition, third angle projection has been introduced along with first angle projection. Construction of the curves 'Evolute and Logarthmic Spiral' has been added in the chapter on 'Curves used in Engineering Practice'.

3. **Calculus for Engineers.** N. Chowdhuri. *N. Chowdhuri Publishers*, Kalyani, West Bengal, Rs. 16.00, 1967, 708 pages.

This book, meant to be a 'home-study text book', for engineering students preparing for the associateship examinations of professional institutions in India, treats the subject in a simple and systematic manner. In this book differential and integral calculus have been treated jointly; twelve chapters out of twenty-five have been devoted to applications and a number of examples and examination papers have been included in every chapter. Anticipating the average student's difficulties, the author has given full guidance in working out all types of examples and particularly all comparatively hard questions set in the professional examinations.

4. **A Text Book of Mathematics for A.M.I.E. Examinations.** Ram Gopal, *Metropolitan Book Co. Private Ltd.*, Delhi, Rs. 20.00, 1966, 720 pages.

The topics in the different subjects in the seven chapters of the book have been dealt conclusively. Exercises included have been taken in most cases from examination papers. Illustrative examples have been added to familiarize the students with the topics.

5. **A Text Book of Applied Mechanics.** S. Ramamrutham. *Dhanpat Rai & Sons*, Delhi, Rs. 15.00, 1967, 756 pages.

This book covers the syllabi on the subject prescribed for the examinations of professional institutions and various universities in India. Problems taken from the Indian institution examinations and the London University examination papers have been solved using M.K.S. and F.P.S. units.

6. **Engineering Mechanics.** G. P. Nagarkar. *Deshmukh Prakashan*, Poona, Rs. 20.00, 496 pages.

This book meant for students of the first year in a four-year engineering course or the second year of the five-year course deals with the theory of engineering mechanics.

7. **R.C.C. for Polytechnics.** G. K. Hiraskar. *A. V. G. Prakashan*, Poona, Rs. 12.00, 1966, 304 pages.

This book is primarily intended to fulfil the needs of the students studying in polytechnics for the diploma course in civil engineering. It deals with all possible types of structural elements such as beams, slabs, columns, footings, staircase and heavy structures like retaining walls and tanks. Examples in M.K.S. units are also given.

8. **Simplified R.C.C. Design.** G. K. Hiraskar. *A. V. G. Prakashan*, Poona, Rs. 16.00, 1967, 398 pages.

This book intended to fulfil the needs of the students of diploma and degree examinations in civil engineering of various Indian universities deals with the structural elements such as beams, slabs, columns, staircase, and heavy structures like retaining walls, tanks, bunkers, silos, and bridges. Examples are given in M.K.S. units.

9. **Carrier Current Engineering.** P. N. Das. *Modern Book Agency Private Ltd.*, Calcutta, Rs. 9.00, 1964, 185 pages.

This book mainly deals with telephone communication over long distance lines. Carrier telephone systems along with the theories and principles of long distance telephone communications have been included together with a fundamental treatment of filters and alternators.

10. **Line Telegraphy.** P. N. Das. *Modern Book Agency Private Ltd.*, Calcutta, Rs. 9.00, 2nd edition, 1965, 193 pages.

This book gives detailed information of recently developed systems. The subject is dealt in a simple and systematic manner, and questions and examples have been provided at end of each chapter to help the students in their tutorial work.

11. **An Introduction to Automatic Telephony.** P. N. Das. *Modern Book Agency Private Ltd.*, Calcutta, Rs. 10.00, 2nd edition, 1966, 226 pages.

This book deals mainly with the principles of Strowger step-by-step system developed exclusively in this country. Its use is primarily restricted for undergraduate students of telecommunication and electrical engineering for mastering the fundamental principles of automatic telephone systems. The basic circuits illustrating the different principles and working of automatic telephone systems have been included so that the readers will have a thorough grasp of the principles and working of the systems.

12. **An Introduction to Manual Telephony.** P. N. Das. *Modern Book Agency Private Ltd.*, Calcutta, Rs. 10.00, 1967, 138 pages.

This book will give the readers a thorough grasp of manual telephony, since it contains the fundamental and easy circuits dealt lucidly. Only megneto and C.B. exchanges have been included in the book. As the C.B.S. exchanges have become obsolete, they have been omitted.

13. **Elements of Machine Design.** P. C. Pandya and G. S. Shah. *Charotar Book Stall*, Anand, 3rd edition, 1967, 716 pages.

In this book fundamental principles of mechanical engineering design are presented to enable students in engineering institutions to get a clear grasp of the basic principles of the subject. It also explains the general theory of mechanical engineering design and sets out problems for the students, aimed at equipping them for design of machine parts. Numerous examples chosen from past examination papers of various Indian universities are also included.

14. **Workshop Experiments for Mechanical Technicians.** D. A. Moore. *Blackie & Son Ltd.*, 15s., 1967, 118 pages.

This book gives the experiments illustrating a number of basic principles taught in the mathematics and science subjects. The need to apply theoretical knowledge in a practical manner is stressed for the student so as to enable him to correlate the subjects of his training. The need for proper instruction in using equipment and the aspects of safety has been well-emphasized.

15. **Classified Examples in Engineering Chemistry.** R. Paul. Parkash Brothers, Ludhiana, Rs. 3.75, 1967, 268 pages.

The problems in this book have been solved step by step to make the basic points clear. A brief summary of theory has been provided at the start of each chapter. Special features of the book are classified arrangement of the matter and the variety of problems included in the book.

16. **Proceedings of the Eighth Conference on the Silicate Industry.** Published by the Akademiai Kiado, Budapest. $19.60, 1966, 808 pages.

The eighth Conference on Silicate Industry was held in Budapest, Hungary, in June 1965. The silicate industry, one of the first industries of mankind, is in these days going through a revolutionary development induced by the achievements of solid state physics, crystal chemistry, etc. and by new practical demands. This volume contains all the principal papers and the more important contributions and discussions. It has been supplemented by a list of participants and an author's and a subject index.

PUBLICATIONS RECEIVED

A copy of a 'Report of the Seminar on City Architecture' has been received from the Mysore Centre of the Institution. This Seminar conducted by the Mysore Centre from December 10-11, 1966, at Bangalore, was held in four Groups dealing in (i) The problem of the city and the need for good architecture, (ii) Zoning of the city for controlled growth—floor space index and planning concepts, (iii) City architecture—Associate problems—Public health, electricity, telephone—Traffic control, and (iv) Suggested control measures, Licensing of architects and surveyors—Bye-laws revisions—Forward planning —Organized development—Problem of co-ordination. This publication also contains the text of the speech delivered by Shri V. V. Giri, former Governor of Mysore State, who inaugurated the Seminar, the proceedings and the recommendations evolved during the Seminar.

A copy of the 'Bulletin of Civil Engineering Research Association' for July 1966 has been received from the Civil Engineering Research Association, 1-7 Great George Street, London, W. 1. It gives the list of members of the Association and its Committees, research projects undertaken, publications, staff, etc.

A copy of a publication entitled 'The Grinding Centre' has been received from the Industrial Diamond Information Bureau, Arundel House, 36-43 Kirby Street, London, E.C. 1. The work of the Centre of improving diamond abrasive products by studying the grinding processes and understanding more clearly the requirements for an ideal abrasive is given in the publication.

A copy of a publication entitled 'Soil Test Computer Programmes' has been received from the United States Department of the Interior, Bureau of Reclamation. Soil tests computer programmes are designed and written for soils testing laboratories having access to data processing facilities. This publication will be useful to soils testing personnel in setting up and writing computer programmes; conversely, it will benefit data processing offices having little or no knowledge of soil tests procedures.

A copy of the 'Annual Report 1964-65' has been received from the Indian Institute of Science, Bangalore. The report gives the working and activities of the Institute, a short statement of the research projects and problems undertaken in each department of the Institute.

A copy of the 'Inauguration Souvenir' of the Kanpur Sub-Centre of the Institution has been received.

A copy of a publication entitled 'Basic Development for the Calcutta Metropolitan District 1966-1986' has been received from the Director, Calcutta Metropolitan Planning Organization, (CMPO), Calcutta. Priced at Rs. 30 per copy, the publication is divided into five parts, *viz.*, (i) Introduction, (ii) Issues and constraints, (iii) The perspective plan 1966-1986, (iv) Immediate action: a Five-Year development programme for the Calcutta Metropolitan District, and (v) Summary of recommendations. Several maps, diagrams and tables have been included to illustrate the publication. The organizational set-up of the CMPO is also given.

A copy of a brochure entitled 'Mineral Engineering Services (Bulletin 800-A) has been received from Dorr-Oliver Inc., Stamford, Connecticut, U.S.A. This liberally illustrated brochure reviews the company's range of services in ore exploration and computerized evaluations, in economic and feasibility studies, in capital and operating cost estimates, and in process research and development. The bulletin also describes Dorr-Oliver's environmental control and land reclamation activities; and defines the scope of the company's services in project design and engineering; in purchasing; and in construction, startup and operating supervision. Bulletin No. 800-A is available free to readers of this publication.

PERSONALS

SHRI S. S. JAUHARI, M.I.Mech.E., M.I.Prod.E., M.I.E., I.O.F.S., has been appointed Additional Director General of Ordnance Factories in control of the Ordnance Equipment Groups of Factories as a Head of Department of Government.

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here

Shri D. N. Sen Gupta

Shri Debendra Nath Sen Gupta, B.E., M.I.E., died in London on June 3, 1967. He was 78. Shri Sen Gupta was Member for life of the Institution.

Born in 1888, Shri Sen Gupta had his general education from the Calcutta University passing the First Arts Examination in 1907. He obtained his B.E. degree in Civil Engineering from the University of Calcutta in 1912. He received his training in the P.W.D., Bengal, during 1912-13 and served as apprentice in the same Department 1914-15. From 1915-17 he worked as Assistant Engineer in the P.W.D., and from 1917-23 in the Irrigation Department. During his service in the P.W.D., he was responsible for the construction of the Queens Way at the Calcutta maidan, the Kidderpore Bridge and other minor irrigation projects. In 1923 he became Executive Engineer in the latter Department, and from 1942 he was working as Superintending Engineer, in the C. and W. Department (Development Circle). In 1952 he retired from active service and settled in England.

Shri Sen Gupta joined the Institution as Member in 1928.

Shri J. V. Shah

Shri Jivraj Valchand Shah, B.Sc., B.Sc. (Tech.), M.I.E., died on February 27, 1967, at the age of 53.

Born in 1914, Shri Shah passed the B.Sc. examination of Bombay University in 1936 and obtained his B.Sc. (Tech.) degree in Electrical Engineering from Victoria University, Manchester, in 1938, where he stood first in 1st division and was awarded the Patuck Prize for the year. For three months he was apprenticed to Fergusson and Paillin, Manchester, and from 1938-41 he worked at the Witton Engineering Works of the General Electric Co. Ltd. as post-graduate apprentice.

In May 1941 he joined the Hindustan Aircraft Ltd., Bangalore, as Designer, and in September 1942 he joined Cooper Engineering Ltd., Satara Road, as Engineer, where he was in charge of the machine shop and was responsible for the complete electrification of the works. He was also organising sales and servicing of engines and machine tools. He became the Joint Works Manager of the company in 1945 and continued till 1947. Thereafter, he spent five months in Rustom and Hornsby, U.K., and visited various machine tools and Diesel engine manufacturing works there. He had also completed a three months' training in the Shell Refinery at Shell Heaven, England. In 1948 he joined Burmah Shell, Bombay, and subsequently became Chief Engineer.

Shri Shah joined the Institution as Associate Member in 1943 and was transferred to Member in 1961.

Shri S. K. Sharma

Shri Shree Krishna Sharma, B.Sc. (Eng.), A.M.I.E., died on June 3, 1967. He was 36.

Born at Chapra in Bihar in 1931, Shri Sharma took his B Sc. (Eng.) degree from the Patna University in 1954 and was awarded the Parvati Raghunath Gold Medal for standing first in Electrical Engineering. He joined the Electrical Engineering Department of the Government of Bihar and worked as Assistant Electrical Engineer, South Bihar Electrical Circle, for two years. In 1956 he was transferred to the Patna Circle and subsequently to the Barauni Investigation Sub-Division. During this period Shri Sharma constructed about 100 miles of H.T. and 20 miles of L.T. lines, 33 kV and 11 kV sub-stations. He had also done the preliminary investigations for the 30 MV thermal power station at Barauni. He visited Yugoslavia and other European countries for specialized training and on his return he was promoted to the post of Electrical Executive Engineer and was posted at Ranchi in 1964. Shri Sharma took an active part in the Institution affairs and was Joint Honorary Secretary of the Bihar Centre during 1962-63 and Honorary Secretary of the Ranchi Sub-Centre from 1964-66.

At a meeting of the Committee of the Bihar Centre held on June 11, 1967, the death of Shri Sharma was mourned.

Shri Sharma joined the Institution as Associate Member in 1959.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column, a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P.O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

RESPONSIBLE, dynamic young man, good personality, energetic, ambitious possessing B.Sc. degree with Mathematics from the Calcutta University, student of the Institution of Engineers (India), got training in Industrial management, having 6½ years experience in machine shop, planning and progress (including Engineering Apprenticeship in Mechanical Engineering with a specialization in machine shop) in a large Government factory and a private firm, having knowledge of foundry, tool room, contract and sales act, etc., needs immediate employment in sales/manufacture/development. Also interested to undergo advanced training either in India or outside with or without service contract, and ready to take training in new fields. Encouraging remuneration expected (Office ref E.S. 301).

RETIRED ELECTRICAL ENGINEER, B.Sc. (Eng.) (Elec. and Mech.), M.I.E., in very good health, specialist in design, testing, maintenance of Electrical machinery and equipment, desires suitable employment as full time Engineer or part-time Consultant. (Office ref. E.S. 299).

CHARTERED CIVIL ENGINEER, 33, with over 12 years experience in India and abroad in steelwork design and construction of all types of structures, and also having over 3 years' administrative experience desires change. (Office ref. E.S. 302).

SPECIALIZED DIE AND TOOL ENGINEER, age 27, possessing diploma in Mechanical Engineering, underwent training in Ashok Leyland Ltd. for 1½ years in repairing and overhauling of mother machine tools; underwent two years intensive training in die and tool designs in the Technical Training Centre, Madras, and passed the prescribed examination; working for the past 3½ years in a most modern tool room as tool designer with equal opportunities of working on the board to design independently jigs, fixtures and press tools and in the workshop in the manufacturing of the tools; seeks suitable challenging position either in production planning, tool design or tool room in any leading manufacturing company anywhere in India or abroad. Also highly interested to undergo further advanced training in either tool engineering or production engineering in any foreign industry or institute on long term service contract basis with guaranteed bright future. (Office ref. E.S. 303).

CIVIL ENGINEER, age 34 years, A.M.I.E. (India), also holding diploma in Civil Engineering from the University of Roorkee, 13 years' experience in designs and construction of buildings and roads in state department; seeks suitable job in Government, semi-Government or private concern of repute, on reasonable terms and conditions. (Office ref. E.S. 304).

ENERGETIC, INTELLIGENT, CIVIL ENGINEER aged 33 years, having over ten years practical experience in various constructional fields like heavy industrial buildings, roads, bridges, tunnels, etc., seeks suitable immediate employment in semi-Government, Government or private concern, reasonable salary acceptable. (Office ref. E.S. 305).

A CONSTRUCTION ENGINEER (35), B.Sc., A.M.I.E. (India), having seven years experience as Assistant Engineer and Assistant Executive Engineer in Government for the construction of irrigation project, roads and bridges (major and minor) and three years as Civil Engineer in private sectors for the construction of a big and modern C.I. pipe factory and other industrial structures like Bunkers, Heavy machine foundations, etc., open for suitable offer. (Office ref. E.S. 306).

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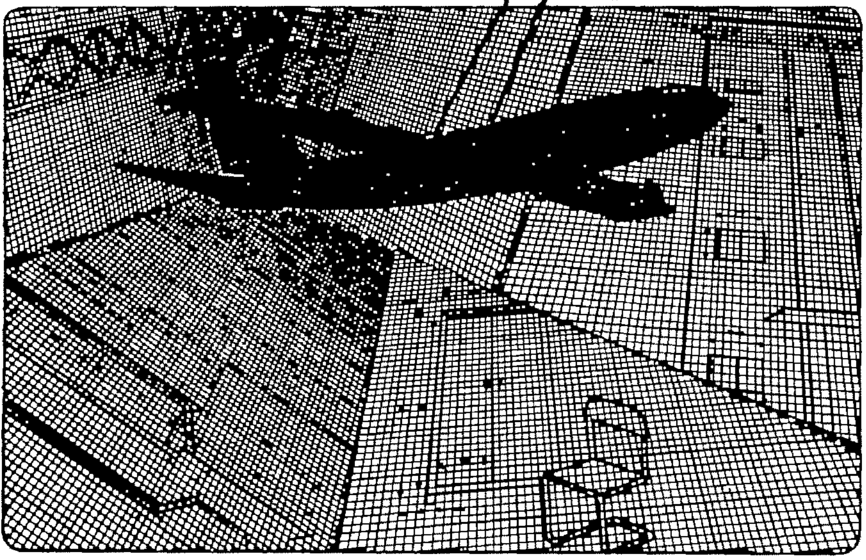

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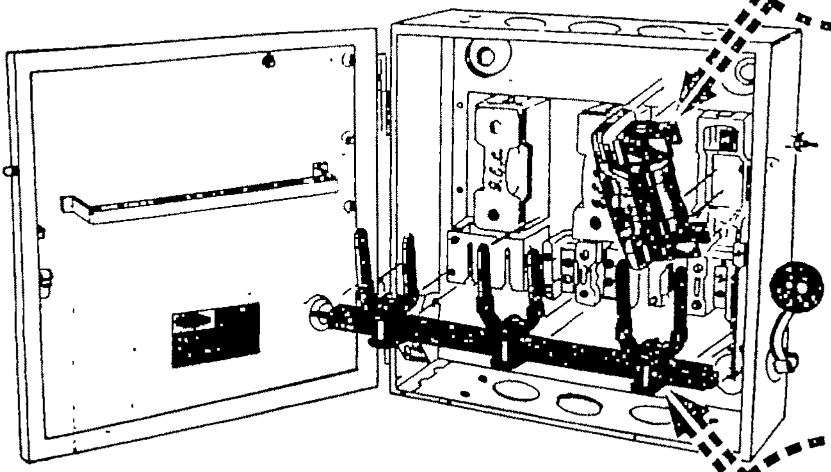

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Local Centres

Andhra Pradesh	Khairatabad, Hyderabad-4 (*Telephone 33066*).
Assam	Near Panbazar Overbridge, Gauhati (*Telephone 3239*).
Bengal	8 Gokhale Road, Calcutta-20 (*Telephone 47-2744*).
Bihar	Hardinge Road, Patna 1 (*Telephone 2-2639*).
Bombay	Ilaco House, Sir Pherozeshah Mehta Road, Bombay 1 (*Telephone 26-3430*).
Delhi	Bahadur Shah Zafar Marg (near Tilak Bridge), New Delhi (*Telephone 27-2702*).
Gujarat	Law College Road, Ahmedabad 6 (*Telephone 78915*).
Jammu & Kashmir	Institution Building, Near Amar Singh Club, Srinagar.
Kerala	Observatory Hill, Trivandrum-1 (*Telephone 2663*).
Madhya Pradesh	Royal Hotel Premises, Civil Lines, Jabalpur (*Telephone 1037*)
Madras	No. 1, Adam's Road, Chepauk, Madras 5 (*Telephone 85879*).
Mysore	No 3, Vidhana Veedhi, Bangalore-1 (*Telephone 25471*).
Nagpur	North Ambazari Road, Nagpur-1 (*Telephone 25617*).
Orissa	Sachivalaya Marg, Unit IV, Bhubaneswar-1 (*Telephone 650*).
Poona	1332 Shivajinagar, Jangli Maharaj Road, Near Shivajinagar Post Office, Poona-5 (*Telephone 57377*).
Punjab, Haryana and Himachal	Sector 19A, Chandigarh (*Telephone 418*).
Rajasthan	C-46 Sarojini Marg, C Scheme, Jaipur (*Telephone 73327*).
Uttar Pradesh	River Bank Colony, Lucknow (*Telephone 25322*).

Sub-Centres

Allahabad	9 Kanpur Road, Allahabad.
Baroda	C/o. Faculty of Technology and Engineering, M.S University, Baroda 1, Gujarat State (*Telephone 4900*).
Bhilai	T-43 Old Administrative Offices, Bhilai, Madhya Pradesh.
Bhopal	112 Type III, B Sector, Piplani P.O., Bhopal, M P (*Telephone 791 City*).
Coimbatore	P S G College of Technology, Peelamedu, Coimbatore 4 (*Telephone 4177*)
Dhanbad	C/o. Head of Electrical Engineering Department, Bihar Institute of Technology, P.O. Sindri Institute, Dhanbad.
Dharwar	C/o. Superintending Engineer, Dharwar Circle's Compound, Dharwar-1, Mysore State.
Durgapur	C/o. Regional Engineering College, P.O. Durgapur 9, District Burdwan.
Jammu	Institution Building, Jammu.
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Kanpur	Elgin Staff Bungalow, Civil Lines, Kanpur (*Telephone 32012 and 34295*).
Kharagpur	C/o. Civil Engineering Department, Indian Institute of Technology, Kharagpur, West Bengal.
Mysore City	C/o. National Institute of Engineering, Mysore 4
Nagarjunasagar	C/o Chief Engineer's Office, P.O Hill Colony, Vijayapuri North, Nalgonda District, Andhra Pradesh.
Neyveli	Thermal Power Station, Neyveli 1, Madras State (*Telephone 2218*)
Ranchi	C/o S. R Kar Roy, South Officepara, P.O. Hinoo, District Ranchi.
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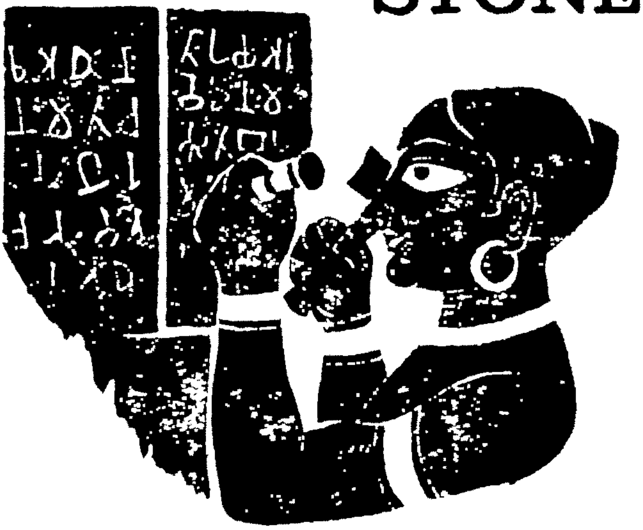

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